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ADF

(TYPE R-346A)

SERVICE/PARTS MANUAL

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SERVICE/PARTS MANUAL

400 ADF

NOTE

This manual contains recommended service information and illustrated parts breakdown applicable to the Cessna 400 ADF (ARC type R-346A and Cessna type CC-407A). This information is supplemented and kept current by Service Letters and Service News Letters published by Cessna Aircraft Company. Recommended replacement parts for your 400 ADF are available from the Cessna Service Parts Center.

This manual supersedes and replaces the previous issue of this manual, D931C1 dated 15 December 1971 and Change 1 dated 1 February 1972.

The information in this Service/Parts Manual does not profess to include all the details of design, production, or variations of the equipment, or to cover all the possible contingencies which may arise during operation, installation, or maintenance. Should special problems arise or further information be desired, contact the Service Department of Cessna Aircraft Company.

CESSNA AIRCRAFT COMPANY

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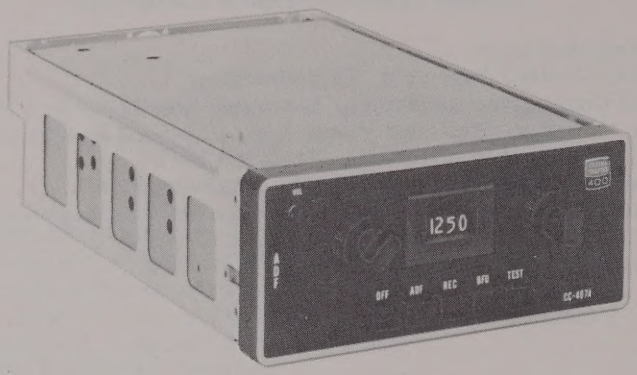
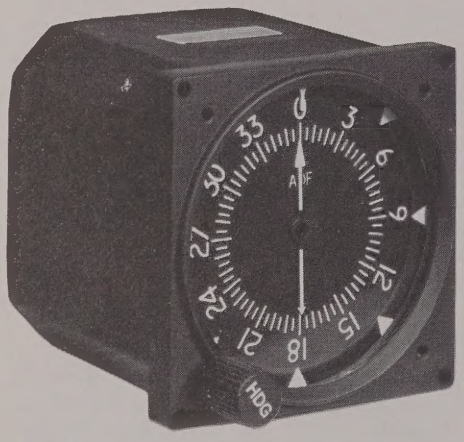
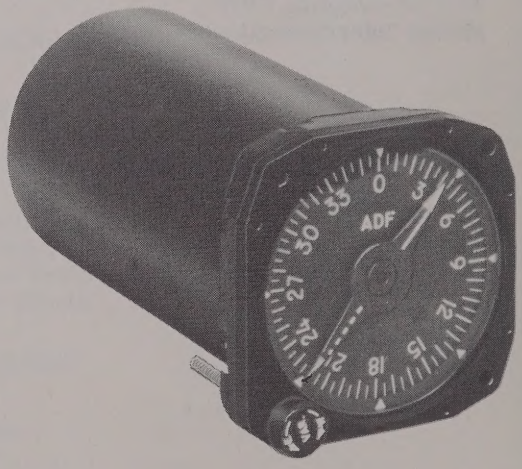


RECEIVER
40950-1001 (Type R-346A - Light shadow grey faceplate)
OR
40950-1001 (Type R-346A - Black faceplate)

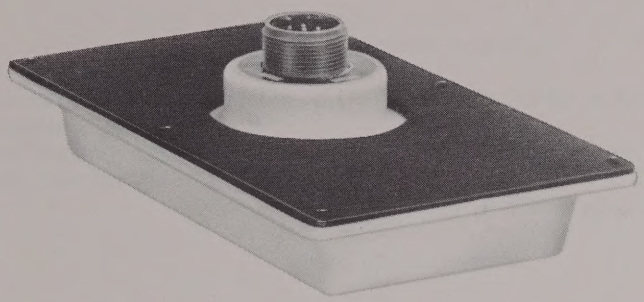


GONIOMETER-INDICATOR
40980-1001 (Type IN-346A)
40980-1101 (Type IN-346B)

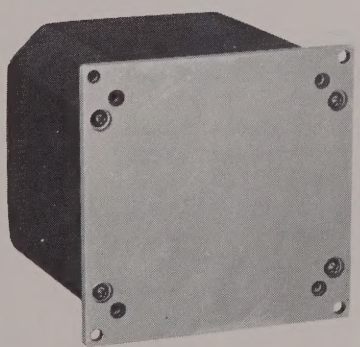


GONIOMETER-INDICATOR
41360-1001 (Type IN-346C)
41360-1101 (Type IN-346D)

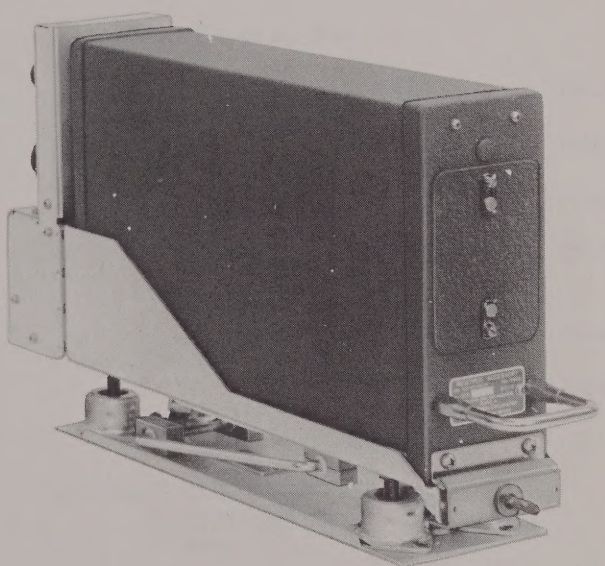
Figure 1-1. Cessna 400 ADF (Sheet 1 of 2)



LOOP ANTENNA
41000-1001 (Type L-346A)



RECEIVER ACCESSORY UNIT
41950 (Type RA-446A)



RECEIVER ACCESSORY UNIT
41340-0001 (Type RA-346A)
OR
41340-0002 (Type RA-346B)
WITH
MOUNTING
41350 (Type M-59-B)

Figure 1-1. Cessna 400 ADF (Sheet 2 of 2)

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

This instruction book provides installation, operation, maintenance, and parts information for the Cessna 400 ADF (Automatic Direction Finder), type CC-407A, manufactured by Aircraft Radio Corporation, Boonton, New Jersey.

1-2. PURPOSE.

The Cessna 400 ADF, shown in Figure 1-1, is a panel-mounted automatic direction finder set which provides continuous, visual bearing indications of the direction from which an RF signal is being received. It can be used for plotting position, for homing, and for aural reception of AM signals. In addition, a crystal-controlled, 1000-Hz beat frequency oscillator permits identification of stations transmitting CW signals. The frequency range of the Cessna 400 ADF is 200 kHz to 1,699 kHz, with 1-kHz increments and a digital readout of the frequency selected. No mechanical bandswitching is required; the frequency range is electronically divided into 200-399 kHz, 400-799 kHz, and 800-1,699 kHz.

1-3. SPECIFICATIONS.

Frequency Range: 200-1, 699 kHz

Frequency Increment: 1 kHz

Functions:
- ADF - Automatic direction finder using loop and sense antennas
- REC - Communication receiver using only sense antenna
- BFO - Identification of keyed CW signals
- TEST - Verify reliability of indicated bearing

Sensitivity:
- ADF - Less than 50 μV/m for maximum of 3 degrees bearing error
- REC - Less than 50 μV/m for 6 dB S+N/N output ratio with 1000 Hz, 30% modulated signal on all bands
- BFO - Less than 50 μV/m for 6 dB S+N/N output ratio on all bands

Selectivity:

6 dB bandwidth, 4 kHz maximum; 65 kB bandwidth, 12 kHz maximum

Image Rejection:

$\geqslant$ 80 dB up to 415 kHz

$\geqslant$ 70 dB from 415 kHz to 800 kHz

$\geqslant$ 55 dB above 800 kHz

Audio Output:

100 mW into 500Ω

Input Power:

1.3 A maximum at 14 Vdc or 28 Vdc

Dimensions:

See Figure 2-1 through 2-7

Weights:

See Figure 2-1 through 2-7

Certification:

TSO C-41b, Class A, Env.

Category:	R-346A	DACBAAX
	Mounting	DACBAAX
	L-346A	AAAAAAE
	IN-346A, -B, -C, -D	DACAAAX
	RA-346A	AAAAAAX
	RA-346B	AAAAAAX
	RA-446A	DAEAAAX

Altitude: R-346A, IN-346C, L-346A, and Mounting 40900, up to 30,000 feet

RA-346A, RA-346B, IN-12-1, IN-13A-1, and M-59B, up to 45,000 feet

1-4. UNITS AND ACCESSORIES.

The units and accessories available for a Cessna 400 ADF installation are listed in Table 1-1. The actual items and quantity supplied may vary depending on whether a receiver accessory unit and an indicator are used in place of the goniometer-indicator, and whether the installation is a single- or dual-ADF. Optional items, which are available on special order and which may be used in addition to or in place of normally supplied items, are indicated by an asterisk (*).

TABLE 1-1. UNITS AND ACCESSORIES

Name	Type No.	Part No.
Receiver (Light shadow grey faceplate)	R-346A	40950-1001
Receiver (Black faceplate) *	R-346A	40950-1000
Mounting (for R-346A)	M-346A	40900
Loop Antenna	L-346A	41000-1001
Goniometer-Indicator	IN-346A	40980-1000
		40980-1001
	IN-346B	40980-1100
		40980-1101
	IN-346C	41360-1000
		41360-1001
	IN-346D	41360-1100
		41360-1101
Receiver Accessory (for single ADF) *	RA-346A	41340-0001
Receiver Accessory (for dual ADF) *	RA-346B	41340-0002
Receiver Accessory *	RA-446A	41950
Mounting (for RA-346A or RA-346B) *	M-59B	41350
Indicator (single-pointer) *	IN-12-1	27310
Indicator (dual-pointer) *	IN-13A-1	27470
RMI Indicator (dual-pointer) *	IN-16A	27226
Connector (for R-346A)	—	38423-0039
Connector (for IN-346A, -B, -C, -D)	—	38423-0040
Connector (for IN-12-1) *	—	14491
Connector (for IN-13A-1) *	—	16743
Connector (for IN-16A) *	—	20034
Sense Antenna Cable Assembly (7 feet)	—	17984-0000
Sense Antenna Cable (9 feet - Used on Cessna Single Engine aircraft as a replacement for 17984-0000) *	RG-195A/U	
Sense Antenna Connector (Used with RG-195A/U Sense Antenna Cable Only) *	—	S2140-1
Sense Antenna Cable Assembly (14 feet) *	—	18637-0000
Sense Antenna Cable (15 feet - Used on Cessna 337 Series Aircraft as a replacement for 18637-0000) *	K-109A	
Sense Antenna Connector (Used with K-109A Sense Antenna Cable Only - Alternate part is AMP No. 51529-1) *	—	85075
Loop Cable Assembly (20 feet)	—	32803
Loop Cable Assembly (9 feet)	—	33827
Goniometer Cable Assembly (4 feet) *	—	30056-0000
Goniometer Cable Assembly (4 feet - Used on Cessna Single-Engine and 337 Series Aircraft as a replacement for 30056-0000) *	—	202-3932-0000
Goniometer Cable Assembly (10 feet)	—	41277-0010
Goniometer Cable Assembly (20 feet) *	—	41277-0020
Goniometer Cable Assembly (30 feet) *	—	41277-0030
Kit, Dropping Resistor, (for 28-volt aircraft) *	—	41287-0002
1 ea Resistor, Fixed, ww, 18Ω ± 5%, 53 W	—	41226
2 ea Screw, Machine, bind h, 8-32, 3/4 in.	—	108-0048
2 ea Lockwasher, Split, No. 8	—	8503
Kit, Sense Antenna Connector ★	—	41287-0001
1 ea Connector, BNC, UG-290A/U	—	11338
4 ea Screw, Machine, fil h, 3-56, 9/32 in.	—	603-0018
4 ea Lockwasher, Split, No. 3	—	4559
1 ea Coaxial Cable RG-178B/U (11 in.)	—	20589
Kit, Goniometer Connector	—	41287-0003
1 ea Connector	—	33871-1003
8 ea Screw, Tapping, pan h, slotted, 4-40, 1/4 in.	—	40468-4016
1 ea Cable, Shielded, two-conductor (8 in.)	—	30056-0000

* Optional

★ Refer to the appropriate Cessna Electronics Service/Parts Manual for alternate sense antenna parts installed on Cessna Aircraft.

TABLE 1-1. UNITS AND ACCESSORIES - Continued

Name	Type No.	Part No.
Kit, Sense Antenna * ★	—	19210
1 ea Antenna Wire (30 feet)	—	12447
1 ea Connector	—	19356
2 ea Insulator	—	12243
1 ea Insulator Assembly	—	19077
1 ea Shackle	—	19357
1 ea Spring	—	12413
1 ea Thimble	—	12324
Doubler Plate (for L-346A) *	—	33237
RF Signal Limiter *	—	41376-0000
Block †	—	S2096-1
Clamp †	—	S2097-1
Guide, Socket †	—	S2098-1
Guide, Pin †	—	S2098-2
Coaxial Cable Jack †	—	S2140-2
Contact, Socket †	—	S2099-2
Compensation Kit (for 2° compensation) *	—	42278-0002
(for 4° compensation) *	—	42278-0004
(for 6° compensation) *	—	42278-0006
(for all compensation) *	—	42278-0012

* Optional
★ Refer to the appropriate Cessna Electronics Service/Parts Manual for alternate sense antenna parts installed on Cessna Aircraft.
† Alternate parts which are installed on Cessna single-engine aircraft and 337 Series aircraft in lieu of 38423-0039 Connector.

1-5. DESCRIPTION OF UNITS.

Receiver. The Receiver (Type R-346A) is a panel-mounted, super-heterdyne receiver with a frequency range of 200 to 1,699 kHz, electronically divided into the following three bands: 200-399 kHz, 400-799 kHz, and 800-1,699 kHz. When a frequency is selected by the control knobs located on the front panel, bandswitching and receiver tuning are automatic, and the selected frequency is displayed digitally. For the automatic direction finding (ADF) mode of operation, the receiver uses the sense antenna and the loop antenna for reception. For the other modes of operation (REC and BFO), the receiver uses only the sense antenna.

The receiver consists of seven plug-in, printed circuit module assemblies, one "mother board" (chassis) printed circuit assembly, and one control assembly, identified as follows: Loop Amplifier Assembly A1, RF Assembly A2, IF Assembly A3, Servo Assembly A4, Phase Detector Assembly A5, N Divider Assembly A6, VCO Assembly A7, Chassis Assembly A8, and Control Assembly A9.

No mechanically-operated, ganged, tuning capacitors are used. Instead, all LC circuits involved in tuning the receiver to a particular frequency use variable-capacitance silicon diodes (varactors). The tuning voltages for the diodes are generated in the digital, frequency-controlled circuitry.

Operating modes of the R-346A are push-button selected. In addition to the ADF, REC, and BFO mode selectors, the pushbutton switch assembly includes a power on-off button (OFF) and a momentary-on TEST button for checking signal reliability in the ADF mode of operation.

Connections to the receiver are made through three connectors on the rear of the unit.

Loop Antenna. The 41000-1001 Loop Antenna (Type L-346A) consists of two insulated coils wound at right angles to each other on a flat ferrite core. The nonsymmetry of the coil windings provides a fixed compensation of 7.5 degrees in the loop antenna, and the high permeability of the ferrite core concentrates the RF field in the coils so that the sensitivity of the L-346A is equal to that of an air-core loop many times larger.

The L-346A is designed for mounting on the exterior surface of the aircraft. The coils and ferrite core are encapsulated in plastic foam and housed in a hard plastic shell. An arrowhead, impressed in the plastic shell, indicates the forward direction for mounting purposes; the centerline of the antenna is indicated by index marks on the fore and aft edges. A seven-pin connector is provided for interconnecting the antenna and receiver.

Goniometer-Indicators. The IN-346A, IN-346B,

IN-346C, and IN-346D Goniometer-Indicators indicate the bearing of the source from which the radio signal is received. Only one of the goniometer-indicators is required for an ADF installation.

The goniometer-indicators differ in the provisions made for compensation of quadrantal error and the inclusion or exclusion of a synchro transmitter for driving an additional ADF indicator, such as the optional IN-12-1. The IN-346A and IN-346B use three inductors, which are selected and connected at the time of installation, for electrical compensation of the quadrantal error, while the IN-346C and IN-346D include an adjustable device for mechanical compensation. Only the IN-346B and IN-346D include the additional synchro transmitter.

The goniometer-indicators are panel-mounted instruments, each of which contains a dial and pointer assembly, a motor, a goniometer, a gear train, a synchro transmitter (IN-346B and IN-346D only), and a pointer-stow switch. The switch acts to stow the bearing pointer at the 90-degree position when the 400 ADF is in the REC or BFO operating mode. The dial of each instrument is calibrated in 5-degree increments with a numerical marking every 30 degrees. It is illuminated with blue-white lighting and is rotatable by a knob located on the front of the goniometer-indicator.

The internal wiring of the goniometer-indicators is determined by the location of the loop and sense antennas on the aircraft. Each unit is factory-wired for a top-located sense antenna and a bottom-located loop antenna. Any other combination of antenna locations requires that simple wiring changes be made in the goniometer-indicator.

Connections between the goniometer-indicator and the other units of the 400 ADF are made through two connectors on the rear of the goniometer-indicator.

Receiver Accessory. The RA-346A, RA-346B, or RA-446A Receiver Accessory provides the goniometer function for the ADF and is used with an ADF indicator such as the optional IN-12-1. The IN-12-1 is a single-pointer indicator available for use with the RA-346A and RA-446A. A dual-pointer IN-13A-1 indicator is available for use with the RA-346B. The optional dual-pointer IN-16A RMI may also be used with any of the receiver accessory units. The receiver accessory and the selected indicator replace the goniometer-indicator normally supplied for a 400 ADF installation.

The RA-346A and the RA-346B are identical in appearance and function, but differ in the number of electromechanical assemblies in each unit. The RA-346B, which is used in a dual ADF installation, includes two electromechanical assemblies, while the RA-346A, which is used in a single ADF installation, includes only one. Each electromechanical assembly consists of a motor, a goniometer, a synchro transmitter, and a compensating mechanism.

The RA-446A Receiver Accessory contains a motor, a goniometer, a synchro transmitter, and a pointer-stow switch. It may also include an inductor circuit, connected as required, for electrical compensation of quadrantal error.

The units are factory-wired for a top sense antenna and a bottom loop antenna installation. For any other combination of antenna locations, the wiring must be changed.

No operating controls or indicators are included in the receiver accessory unit. For the RA-346A and RA-346B, connections to the other units of the set are made through connectors which mate with the cable assemblies supplied, and a connector on the rear of the unit which mates with the connector on the 41350 Mounting (Type M-59B). For the RA-446A, connections are made to the two connectors on the rear of the unit.

Mountings. Mounting 40900 is made of aluminum alloy and is used to mount the receiver in an instrument panel. A removable bracket at the rear of the mounting is used for mounting the receiver connector, the sense antenna connector, and, if supplied, the goniometer (receiver accessory) connector and 28-volt-supply dropping resistor.

The M-59B Mounting is used to shock-mount the RA-346A or RA-346B Receiver Accessory. An adjustable flange, on the front of the mounting, secures the unit to the mounting base. Flexible metal straps on the underside of the mounting are used to ground the receiver accessory and mounting to the airframe. The mounting provides connections between the receiver accessory and both the receiver and indicator.

Cable Assemblies. An open-wire cable harness assembly is required but not supplied for connecting the audio output of the receiver and for connecting operating power to the receiver and goniometer-indicator or the optional receiver accessory and selected indicator. The cable harness assembly is fabricated using individual wires (not supplied) and the connectors (which are supplied) specified in Table 1-1.

A loop antenna cable assembly and a sense antenna cable assembly are supplied. Also, an unterminated length of cable is supplied for connecting the goniometer output of the goniometer indicator to the receiver, and different lengths of complete goniometer cable assemblies are available for connecting the receiver accessory unit to the receiver. The lengths of all these cables are critical and must be used as supplied.

The loop cable assembly is used to connect the loop antenna to the goniometer-indicator or the receiver accessory. The cable assembly is normally supplied in a 20-foot length. A 9-foot length is available as an option. To compensate for the difference in length, the 9-foot cable includes two 75-pF capacitors to equal the capacity of the 20-foot length.

The sense antenna cable assembly is used to connect the sense antenna to the receiver. It is normally supplied 7 feet long. A 14-foot length is available as

an option. The 7-foot cable uses RG-62/U coaxial cable while the 14-foot length uses RG-114A/U coaxial cable so that either cable assembly has a capacity of 100±5pF.

A 4-foot length of unterminated, two-conductor, shielded cable is supplied for connecting the goniometer-indicator to the receiver. If a receiver accessory is supplied, a choice of a prefabricated, 10-, 20-, or 30-foot goniometer cable assembly is available to allow flexibility in locating the receiver accessory and connecting it to the receiver.

Accessories. Connectors are supplied, as specified, for fabricating the cable harness assembly required to interconnect the receiver and the other units of the Cessna 400 ADF. In addition, two connector kits are supplied. The sense antenna connector kit is installed on the bracket attached to the rear of the receiver and is used for connecting the sense antenna through the sense antenna cable termination to the receiver. The goniometer connector kit is also installed on the bracket attached to the rear of the receiver and is used to connect the goniometer output of the receiver accessory through the goniometer cable termination to the receiver.

A voltage dropping resistor kit is supplied for using the Cessna 400 ADF in aircraft equipped with 28-volt primary power. This kit is installed on the bracket attached to the rear of the receiver. Provisions should be made to allow air to circulate around the resistor.

Doubler plate, Part No. 32237, may be used to facilitate the installation of the loop antenna. When secured to the aircraft skin, it allows the loop antenna to be removed and reinstalled easily. The doubler plate also acts as a stress distributor, minimizing the stress on the aircraft skin at each mounting point.

Sense Antenna Kit, Part No. 19210, includes all the parts necessary for constructing and installing a sense antenna. However, for specific parts used on Cessna installations, refer to the appropriate Cessna Electronics Service/Parts Manual. If Cessna parts are not desired, use of the kit is recommended. Insulator Assembly, Part No. 19077, is supplied with the sense antenna kit and may also be supplied individually. The insulator assembly is used for coupling the sense antenna to the sense antenna, cable assembly. It is desirable that this insulator assembly, or its equivalent, be used to retain the electrical characteristics of the sense antenna cable assembly.

RF Signal Limiter, Part No. 41376, is used to eliminate interference from transmitter signals which may be picked up by the sense antenna. It is connected between the sense antenna cable and the receiver. The limiter includes six IN3604 diodes to eliminate interference from VHF communication equipment and a low-pass filter to eliminate interference from DME and transponder equipment. The parts are encapsulated within a rigid body consisting of a female connector at one end and a male connector at the other end joined by an intermediate spacer. The limiter does not affect the performance of the receiver.

Compensation Kit 42278- ( ) is used, if required, in the IN-346A, IN-346B, and RA-446A for electrical compensation of quadrantal error. Three of the four kits available contain three selected-value inductors to compensate for a 2-, 4-, or 6-degree error, depending on the kit selected. The remaining kit contains all inductor values to cover the total range of compensation.

1-6. FUNCTIONAL DESCRIPTION.

General. The Cessna 400 ADF provides navigation bearings on any continuous radio signal between 200 kHz and 1,699 kHz. It can also be used as a communication receiver and for identification of keyed CW signals. A functional block diagram is shown in Figure 1-2.

Frequency Selection. The frequency range of the R-346A Receiver is divided into three bands: 200-399 kHz, 400-799 kHz, and 800-1,699 kHz. When a frequency is selected, the required band is automatically selected.

As shown in the schematic diagram, Figure 5-1, the loop amplifier, sense antenna, RF amplifier, mixer, and voltage-controlled oscillator (VCO) circuits include a separate resonant circuit for each operating band. These circuits consist of the secondary winding of an RF transformer or an RF coil and a trimmer capacitor which are electronically tuned to the selected frequency by a varactor (variable-capacitance diode). A tuning voltage developed in the phase detector supplies the appropriate dc reverse bias voltage to vary the capacitance of the varactor.

The secondary winding of the RF transformers used in the loop and RF amplifier circuits and the coils used in the mixer and VCO circuits are connected in series. In each circuit, for Band 1 operation, all windings are used to provide maximum inductance. For Band 2, the secondary winding of one RF transformer, or the winding of one coil, is effectively removed by shorting it electronically to ground through a capacitor, reducing the total inductance. For Band 3, the secondary windings of two RF transformers, or the windings of two coils, are effectively removed by shorting each winding to ground through a capacitor, reducing the total inductance still more. In each case, the grounding or ungrounding of the capacitors is effected by turning a transistor on or off by a logic line from the frequency determining circuits.

As an example, in the loop circuit shown in Figure 1-3, for Band 1 operation, A1Q1 and A1Q2 are turned off; that is, they will not operate since no operating voltage is applied by the logic line. Under this condition, A1C7 and A1C8 are effectively disconnected from ground and maximum inductance (all secondary windings of A1T1, A1T2, and A1T3) is provided. For Band 2 operation, only A1Q1 is turned on, which connects A1C8 to ground and effectively removes the secondary winding of A1T1 from the circuit. For Band 3 operation, both A1Q1 and A1Q2 are turned on, grounding both A1C7 and A1C8. This effectivity removes the secondary windings of A1T1 and A1T2

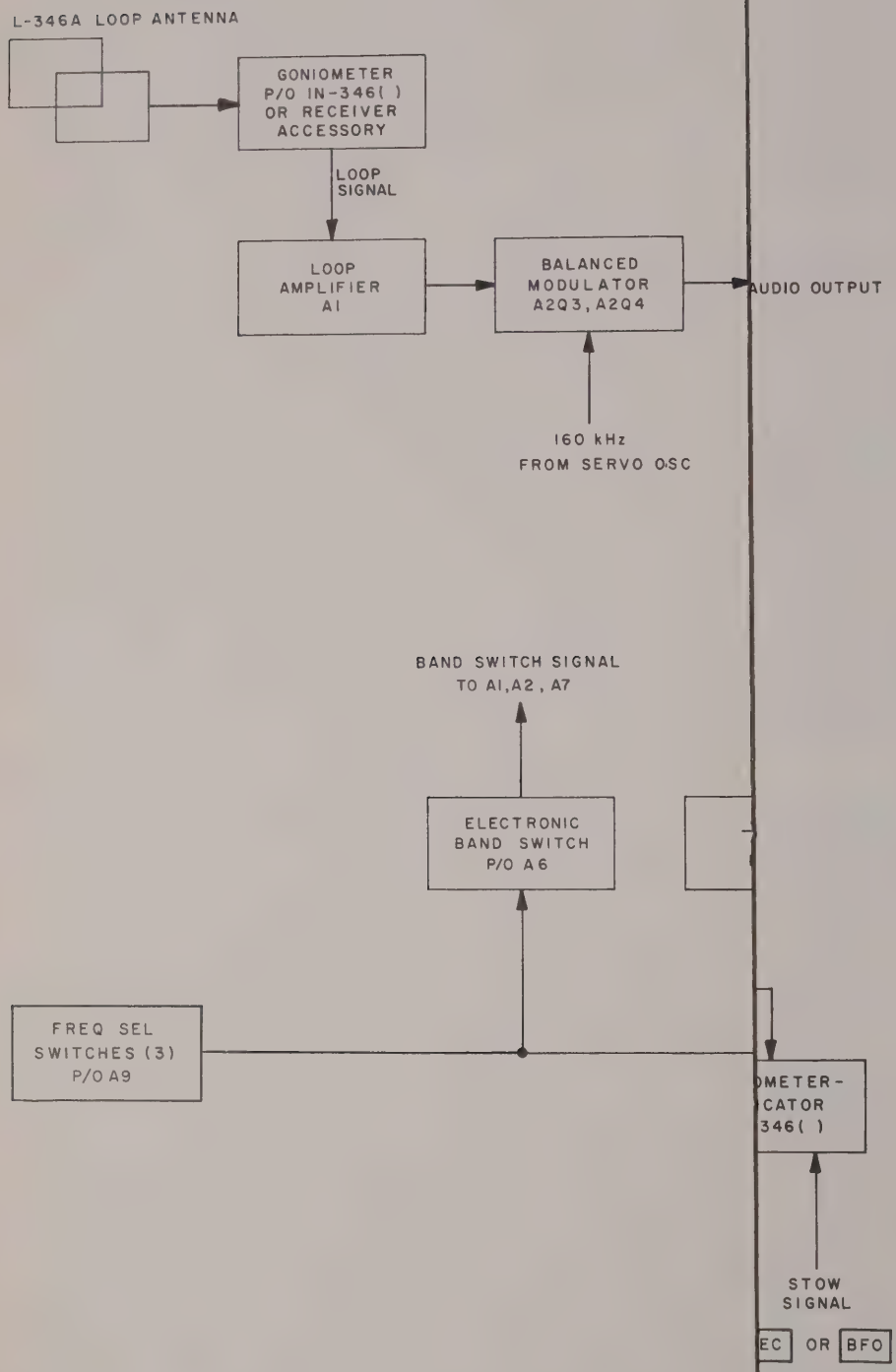


Figure 1-2. Cessna 400 ADF,

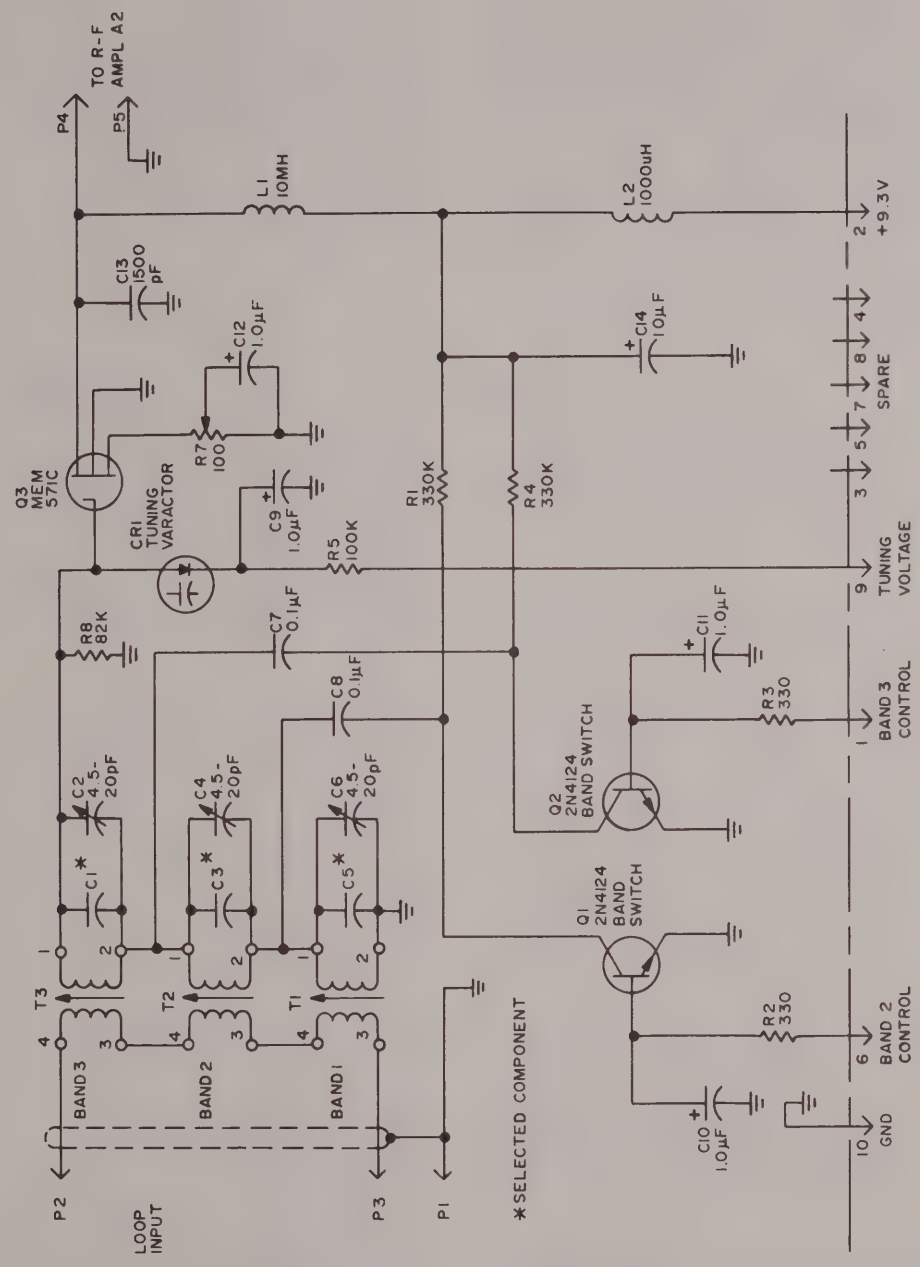


Figure 1-3. A1, Loop Amplifier, Simplified Schematic Diagram

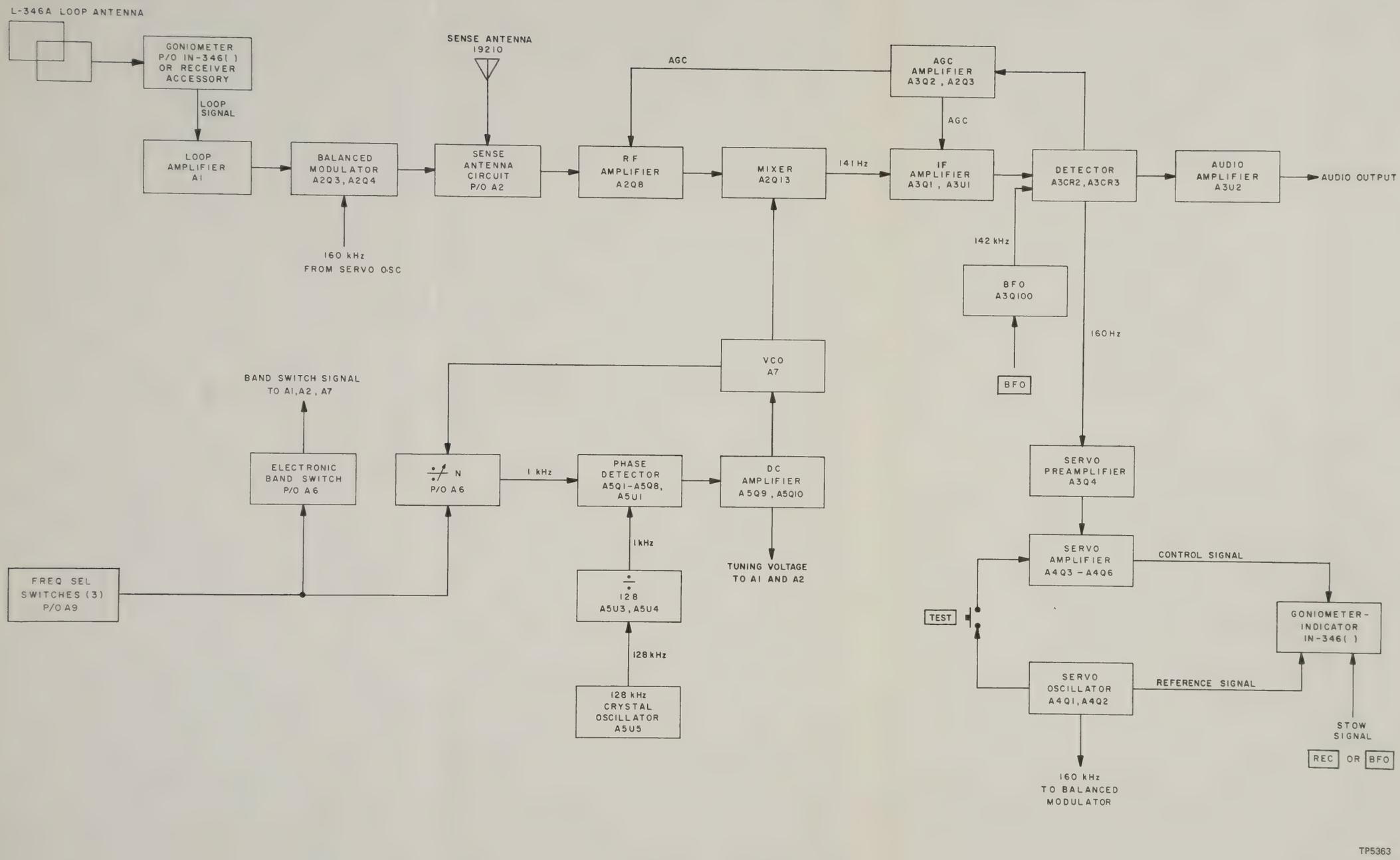


Figure 1-2. Cessna 400 ADF, Functional Block Diagram

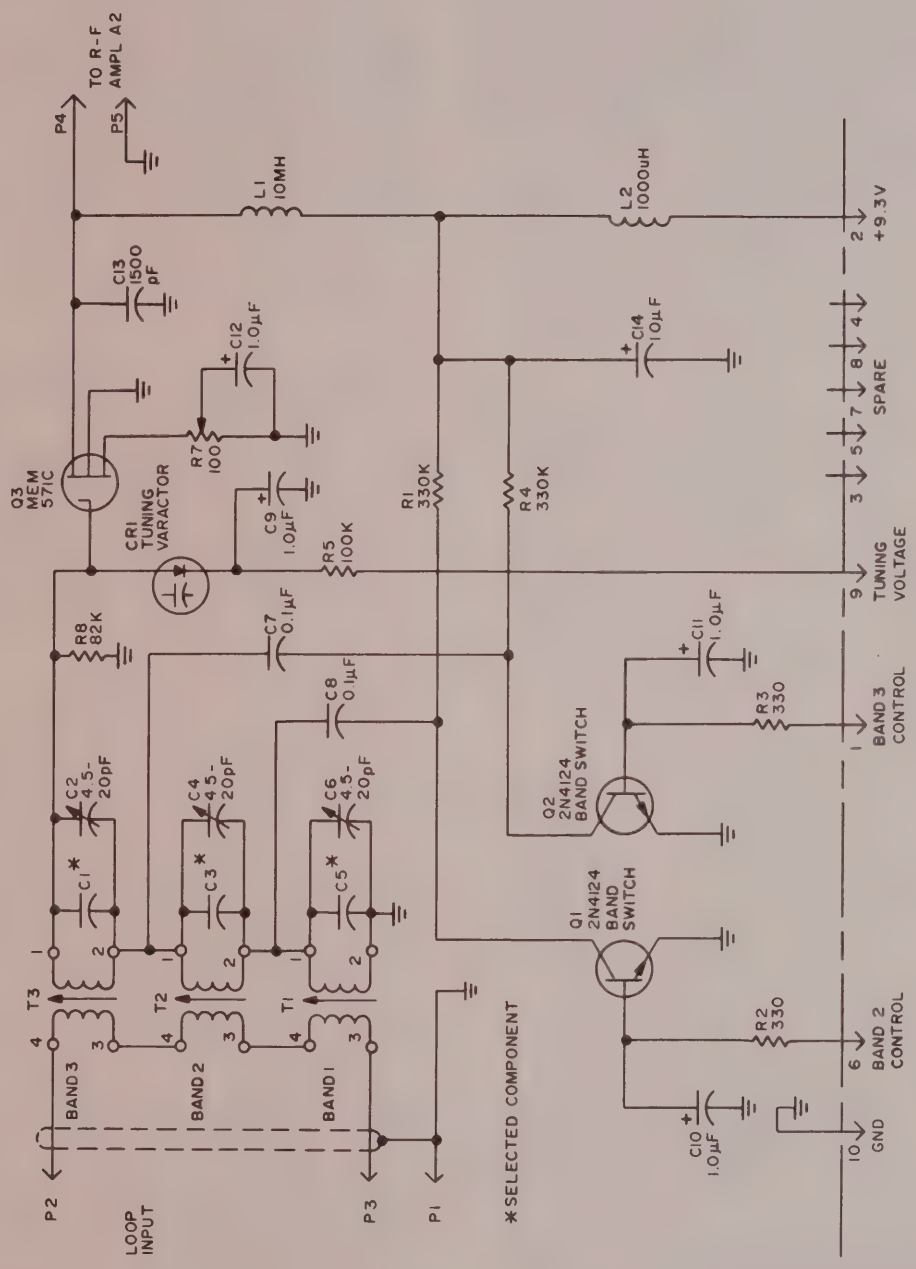


Figure 1-3. A1, Loop Amplifier, Simplified Schematic Diagram

from the circuit, so that only the secondary of A1T3 provides the inductance.

In the sense antenna circuit, to obtain the inductance required, switching diodes A2CR3 and A3CR4 are used to connect A2L3 and A2L4, as required, in parallel with the sense antenna input coil, A2L1. Also, diodes A2CR1 and A2CR2 are used to connect the tuned-circuit coils, A2L5 and A2L6, as required, in parallel with the secondary winding of coupling transformer A2T1. The diodes are switches in or out of the circuit by transistors A2Q6 and A2Q7, which are turned on or off by logic lines.

For Band 1 operation, A2Q6 and A2Q7 are turned off (no base voltage), which opens all four switching diodes to provide the maximum inductance of A2L1 and the maximum inductance of the secondary winding of A2T1. Also A2Q5 is turned on, which connects A2C12 across the winding of A2T1 for trimming at the high end of Band 1.

For Band 2 operation, only A2Q6 is turned on, A2CR1 then conducts and parallels A2L5 with the secondary of A2T1; A2CR3 conducts, and parallels A2L3 with A2L1. Also, A2Q5 is turned off, which removes A2C12 and allows Band 2 to be trimmed with its own trimmer capacitor, A2C18.

For Band 3 operation, A2Q6 is turned off and A2Q7 is turned on. A2CR2 then conducts, connecting A2L6 in parallel with the secondary of A2T1, and A2CR4 conducts, connecting A2L4 in parallel with A2L1.

The receiver operating frequency is selected by three switches in increments of 100 kHz, 10 kHz, and 1 kHz. The switch positions determine the open or grounded condition of logic lines applied to the N divider module of the frequency determining circuit. The N divider also receives an input from the voltage-controlled oscillator and reduces this signal to a 1-kHz signal which is applied to the phase detector. The phase detector also receives a 1-kHz signal supplied by 128-kHz crystal oscillator A5U5 through 128-divider A5U3 and A5U4. These two signals are compared in the phase detector to produce a dc error voltage which is amplified in dc amplifier A5Q9 and A5Q10 and applied to the voltage-controlled oscillator to determine the frequency of the signal supplied to mixer A2Q13. A tuning voltage supplied by the phase detector is also applied to the loop amplifier, sense antenna circuit, RF amplifier, and mixer.

Automatic Direction Finder Operation. When ADF operation is selected, signals received by both the sense antenna and the loop antenna are used in the receiver. The RF signal from the loop antenna, which is 90° out of phase with the signal from the sense antenna, is connected directly to the stator windings of the goniometer in the goniometer-indicator or the receiver accessory. An RF field developed in the stator winding induces a voltage into the goniometer rotary winding. This induced voltage is proportional to the difference between the bearing represented by the angular position of the rotor and the bearing of the received signal. The difference voltage, supplied as a loop input signal to the receiver, is amplified in loop amplifier A1, where its phase is shifted 90°. The resulting output from A1 is an amplified RF difference signal that is either in phase or 180° out of phase with the sense antenna signal. This difference signal is applied to balanced modulator A2Q3 and A2Q4.

A 160-Hz modulating voltage, in opposite phase, is also supplied to each half of the balanced modulator from the servo oscillator, A4Q1 and A4Q2, and is combined with the difference signal from A1. The output signal from the balanced modulator is applied to the sense antenna circuit in A2 and is added to or subtracted from the induced sense antenna signal.

The addition or subtraction is determined by the phase relationship between the loop amplifier output signal and the sense antenna signal.

The output from the sense antenna circuit is amplified in A2Q8 and applied to mixer A2Q13. The mixer also receives an input signal from the voltage-controlled oscillator. The mixer produces an IF output signal of 141 kHz, which is amplified in A3Q1 and A3U1 before it is applied to detectors A3CR2 and A3CR3. The audio modulation portion of the IF signal is detected and applied to audio amplifier A3U2 for amplification and application to the aircraft audio circuits. A portion of the detected signal is also returned through AGC amplifier A3Q2 and A3Q3 to control the RF and IF amplifiers.

A 160-Hz signal from the detector is applied to servo preamplifier A3Q4 for amplification. The output of A3Q4 is filtered and amplified further by servo power amplifier A4Q3-A4Q6; it is then applied to the control winding of the servo motor in the goniometer-indicator or receiver accessory. A 160-Hz reference voltage is provided to the servo motor from servo oscillator A4Q1 and A4Q2, since the fixed phase winding of the servo oscillator is a portion of the 160-Hz frequency-determining circuits. The direction in which the shaft of the servo motor rotates is dependent upon the phase relationship between the 160-Hz reference voltage and the 160-Hz voltage applied to the control winding. Since the shaft of the servo motor is mechanically linked to the rotor of the goniometer, any rotation of the servo motor shaft will cause a similar rotation of the goniometer rotor. The phase of the voltage applied to the control winding of the servo motor will be such as to cause the motor to rotate in a direction that will reduce the difference between the angular position of the goniometer rotor and the direction of the received RF signal. When this difference is reduced to zero, the servo motor will stop. The pointer on the goniometer-indicator will then indicate the bearing of the station being received.

A TEST switch on the receiver panel allows momentary injection of the 160-Hz signal from the servo oscillator directly into the servo amplifier. This 160-Hz signal slews the goniometer and causes the pointer to rotate away from the bearing of the signal being received. When the TEST switch is released, the goniometer and the pointer will return to the

bearing of the received signal, provided the intensity of the received signal is sufficient for a usable bearing indication and the set is operating normally.

Communication Receiver Operation. In the REC mode of operation, operating power is removed from loop amplifier A1 and balanced modulator A2Q3. Also, the pointer of the goniometer-indicator is stowed at 90° as an indication that the ADF mode is not functioning. Only the sense antenna is used, and the RF voltage induced in the sense antenna is processed through the receiver in the same manner as for ADF operation.

For the 90-degree pointer stowage, primary power is applied to the fixed phase of the servo motor through the contacts of the pointer-stow switch in the goniometer-indicator. The 160-Hz signal is fed to the control winding and the pointer slews until it reaches the 90-degree position, at which time primary power is removed from the motor and the pointer remains at the 90-degree position.

Keyed CW Signal Reception. When BFO operation is selected, a 142-kHz output from beat-frequency-oscillator A3Q100 is injected into the tuned input circuit of detector A3CR2 and A3CR3. This output beats with the amplified IF signal to produce a 1000-Hz tone which is used for identification of keyed CW signals. All other circuit operation is identical to the REC mode.

SHOP NOTES:

SECTION 2

INSTALLATION

2-1. UNPACKING.

Carefully remove the equipment from the packing case. Inspect each item for damage. Be sure the operating controls on the receiver function properly. Check the units and accessories against the packing slip to be sure all items have been received and removed from the packing case.

2-2. INSTALLATION CONSIDERATIONS.

The location and installation of the units will depend on the type of aircraft in which the equipment is to be installed; however, the following requirements are applicable to all types of aircraft.

Unit Dimensions and Installation Area. Installation and outline dimensions are shown in Figures 2-1 through 2-7. Compare the space requirements of each unit with the area being considered. Locate the units so that they are accessible for inspection and maintenance and in an area free from excessive vibration and heat.

Location of Receiver. Install the receiver within convenient view and reach of the operator. Allow sufficient clearance on all sides of the unit for ventilation. Allow sufficient clearance at the rear for cable and external wiring connections to be made.

CAUTION

On 28 Vdc operation, the rear of the receiver may reach temperatures which could damage adjacent cables or wiring. Make sure that sufficient ventilation is provided at the rear of the receiver.

Location of Goniometer-Indicator. The goniometer-indicator should be installed within convenient view and reach of the operator. Allow at least 3 inches of open space at the rear of the unit for installing the connectors. Because the lengths of the interconnecting cables are critical and cannot be altered, the distances between the goniometer-indicator and the receiver and loop antenna must not exceed the cable lengths ordered for the specific installation.

Location of Loop Antenna. The loop antenna may be mounted on either the top or bottom of the aircraft, but should be located as near as possible to the centerline of the aircraft. The loop antenna should be kept away from other antennas and structural members which may cause distortion of the radio field pattern. Because the length of the loop cable is critical and cannot be altered, the distance between the loop antenna and the goniometer-indicator must not exceed the cable length of 9 feet for Loop Cable 33827 or 20 feet for Loop Cable 32803.

Location of Receiver Accessory. The receiver-accessory may be installed in any convenient location. Because the lengths of the interconnecting cables are critical and cannot be altered, the distance between the receiver and the receiver accessory must not exceed 30 feet, and the distance between the loop antenna and the receiver accessory must not exceed 20 feet. Allow sufficient clearance on all sides of the unit for shock-mount travel.

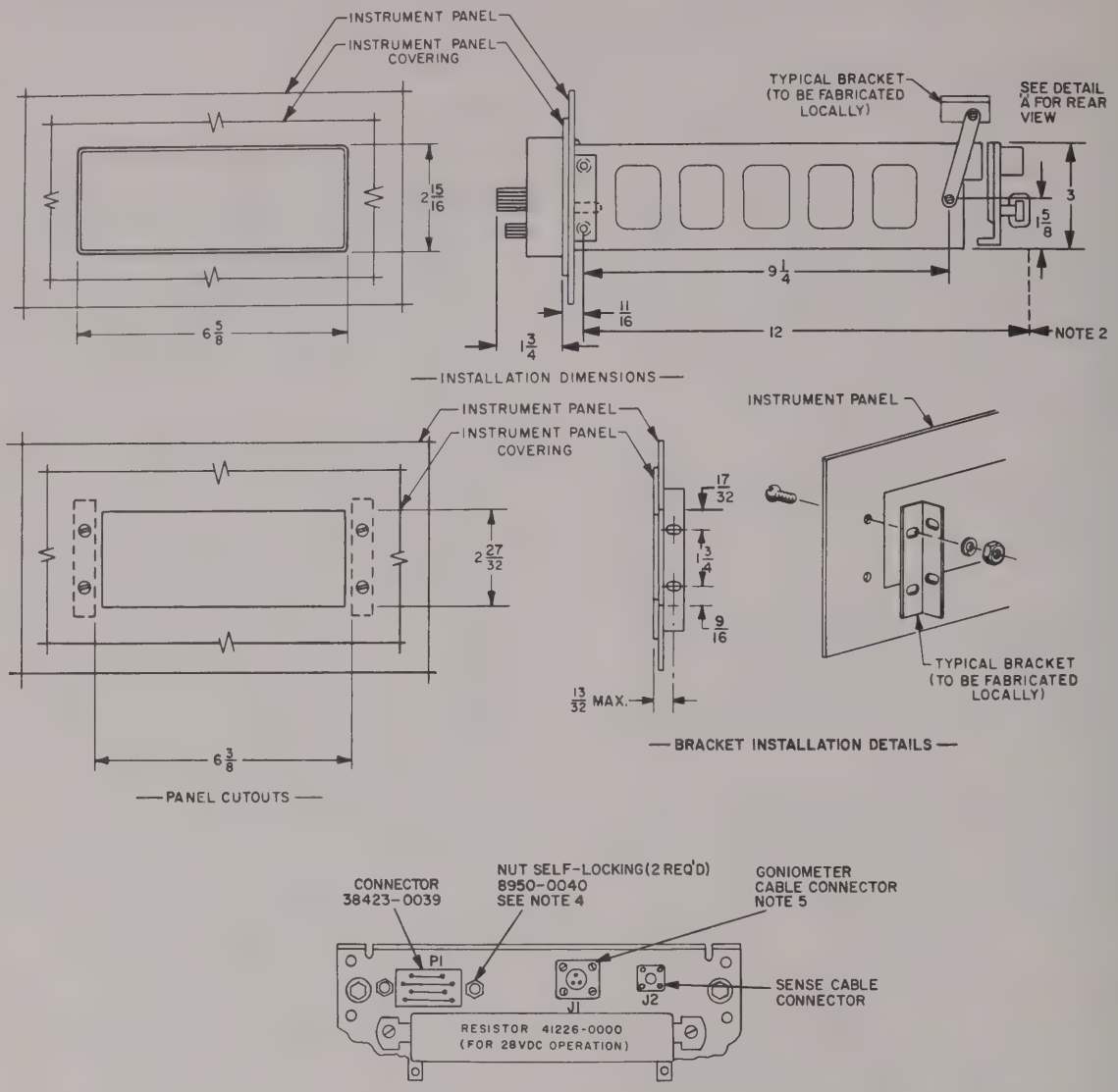
Characteristics of Sense Antenna. It is difficult to obtain optimum antenna arrangements on any but the largest aircraft; even then certain compromises are to be expected. An ADF usually performs satisfactorily using a "standard" range antenna. A satisfactory type of wire antenna is the balanced- or symmetrical-T, although an inverted-L or unbalanced-T may also provide acceptable results. However, the balanced-T antenna is preferred because it is not responsive to horizontally polarized transmissions. (Response to horizontal radiation is undesirable where accurate indications of overstation position are required.) The sense antenna may be mounted on either the top or bottom of the aircraft, but should be located as near the centerline as possible. The flat-top portion of the antenna should not be less than 8 feet in length. A length up to 12 feet may give increased performance. A longer sense antenna will provide better communication receiver sensitivity, but may result in sluggish ADF operation. The average clearance between the antenna and the skin of the aircraft should be 10 inches or more. Sense Antenna Kit 19210 includes all the parts necessary for constructing and installing a sense antenna.

Depending on the location of the sense antenna, the feed-through insulator for the sense antenna should be mounted on either the top or bottom of the aircraft, as near as possible to the mid-point of the aircraft. The sense antenna cable is supplied in either a 7- or 14-foot length. (Where extremely short runs are encountered, it may be more convenient to fabricate a 3-1/2-foot section of RG-58/U cable locally, although no performance advantage would result.) Each of the sense antenna cables has a capacitance of 100 pF. To maintain proper antenna tuning, the lengths of these cables must not be altered. The 7-foot cable is preferred because of its lighter weight, flexibility, and ruggedness.

2-3. INSTALLATION OF RECEIVER AND MOUNTING.

To install the receiver and mounting, proceed as follows:

Step 1. If a knockout panel and mounting flanges are not provided on aircraft instrument panel, cut required opening in panel. Fabricate two front mount-

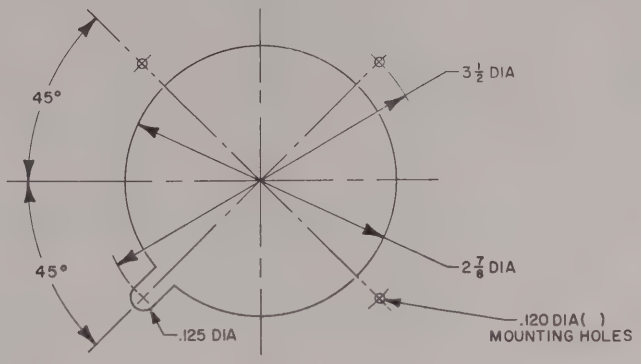


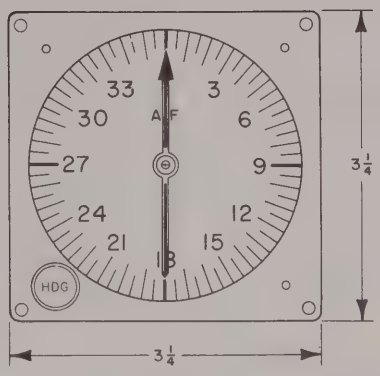
DETAIL A

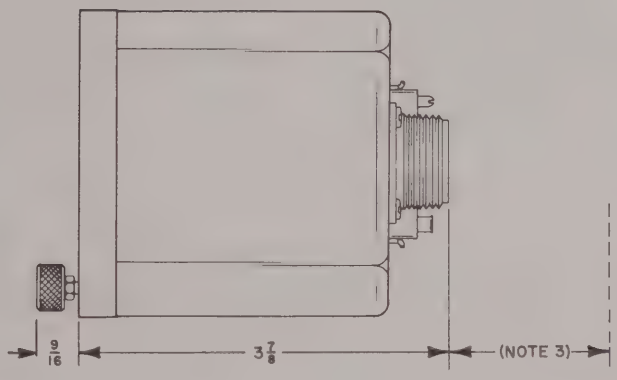
NOTES:

1. DIMENSIONS ARE IN INCHES.
2. ALLOW 2 INCHES FOR CABLE BEND.
3. MOUNTING HARDWARE NOT SUPPLIED.
4. USE SELF-LOCKING NUTS IN LIEU OF REGULAR HARDWARE WITH GUIDES #35862-0001 AND #35862-0002 FOR "FLOATING" CONNECTOR ON MOUNTING ASSEMBLY. THIS "FLOAT" IS ACCOMPLISHED BY BACKING OFF THE NUTS 1/4 TURN FROM THEIR TIGHTENED POSITIONS.
5. NOT USED WITH IN-346 ( ). GONIOMETER CABLE IS WIRED DIRECTLY TO P1.
6. WEIGHT: 4.0 LB INCLUDING MOUNTING.

Figure 2-1. R-346A Receiver with Mounting 40900, Installation Diagram



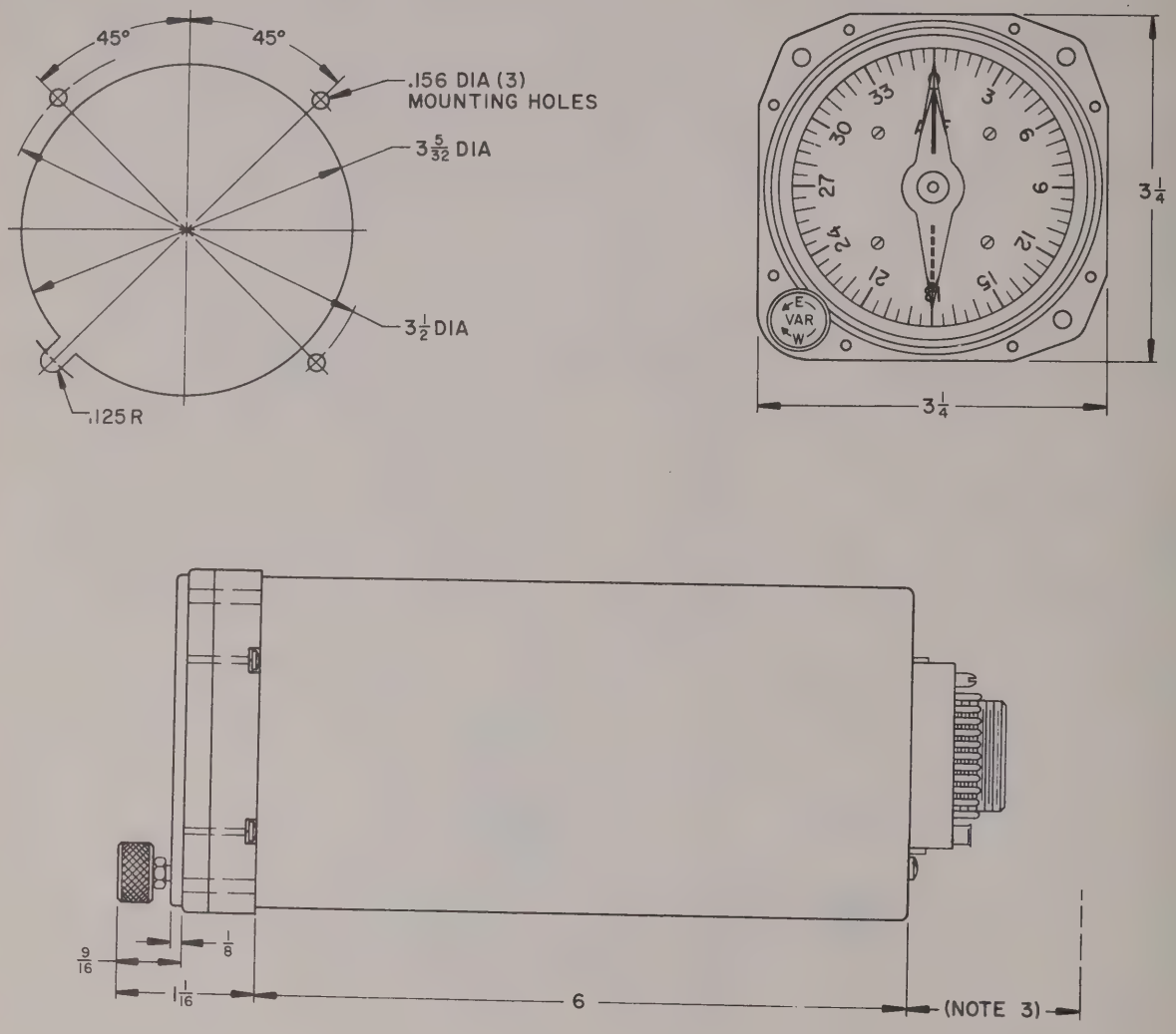




NOTES:

1. DIMENSIONS ARE IN INCHES.
2. WEIGHT: IN-346A: 1 POUND.
   IN-346B: 1.2 POUNDS.
3. ALLOW 3 INCHES FOR PLUG REMOVAL.

Figure 2-2. IN-346A and IN-346B Goniometers-Indicators, Installation Dimensions



NOTES:

1. Dimensions are in inches.
2. Weight: IN-346C: 2.0 pounds
   IN-346D: 2.2 pounds
3. Allow 3 inches for plug removal.

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Figure 2-3. IN-346C and IN-346D Goniometer-Indicators, Installation Dimensions

ing brackets as shown in Figure 2-1. Both flanges or brackets must be clean, bare metal for proper grounding or receiver.

Step 2. Drill and countersink holes in flanges or brackets as shown in Figure 2-1.

Step 3. Route receiver cable assembly from rear of instrument panel through panel opening. Attach external cable and connection to the bracket provided at the rear of mounting.

Step 4. Slide mounting through hole in instrument panel and secure in place using four No. 6-32 flat head screws and nuts.

Step 5. Fabricate and attach rear mounting brackets (see Figure 2-1) to two holes in sides of mounting.

Step 6. Slide receiver into mounting. Make certain receiver connector and mounting connector are properly mated. Secure receiver to mounting by rotating the recessed locking screw near bottom left edge of receiver front panel.

2-4. INSTALLATION OF GONIOMETER-INDICATOR.

Installation dimensions for the IN-346A and IN-346B are shown in Figure 2-2 and those for the IN-346C and IN-346D are shown in Figure 2-3. As supplied, the goniometer-indicator is wired for a bottom-mounted loop antenna and top-mounted sense antenna. Before installing the goniometer-indicator, note the proposed installation locations of the loop and sense antennas, then check the internal wiring connections of the goniometer-indicator for agreement with the antenna locations (see Figure 2-8). Install the goniometer-indicator on a shock-mounted instrument panel with suitable hardware.

2-5. INSTALLATION OF RECEIVER ACCESSORY AND MOUNTING.

To install the RA-346A or RA-346B Receiver Accessory and mounting, proceed as follows:

Step 1. Drill aircraft mounting surface for eight No. 8-32 screws, located as shown in Figure 2-4.

Note

Mounting may be used as template for locating mounting holes.

Step 2. Place mounting in place and secure with suitable hardware.

Step 3. Note the proposed installation locations of the loop and sense antennas, then check the internal wiring connections of the receiver accessory for agreement with the antenna locations (see Figure 2-9 or 2-10). (As supplied, the receiver accessory is wired for a bottom-mounted loop antenna and a top-mounted sense antenna.)

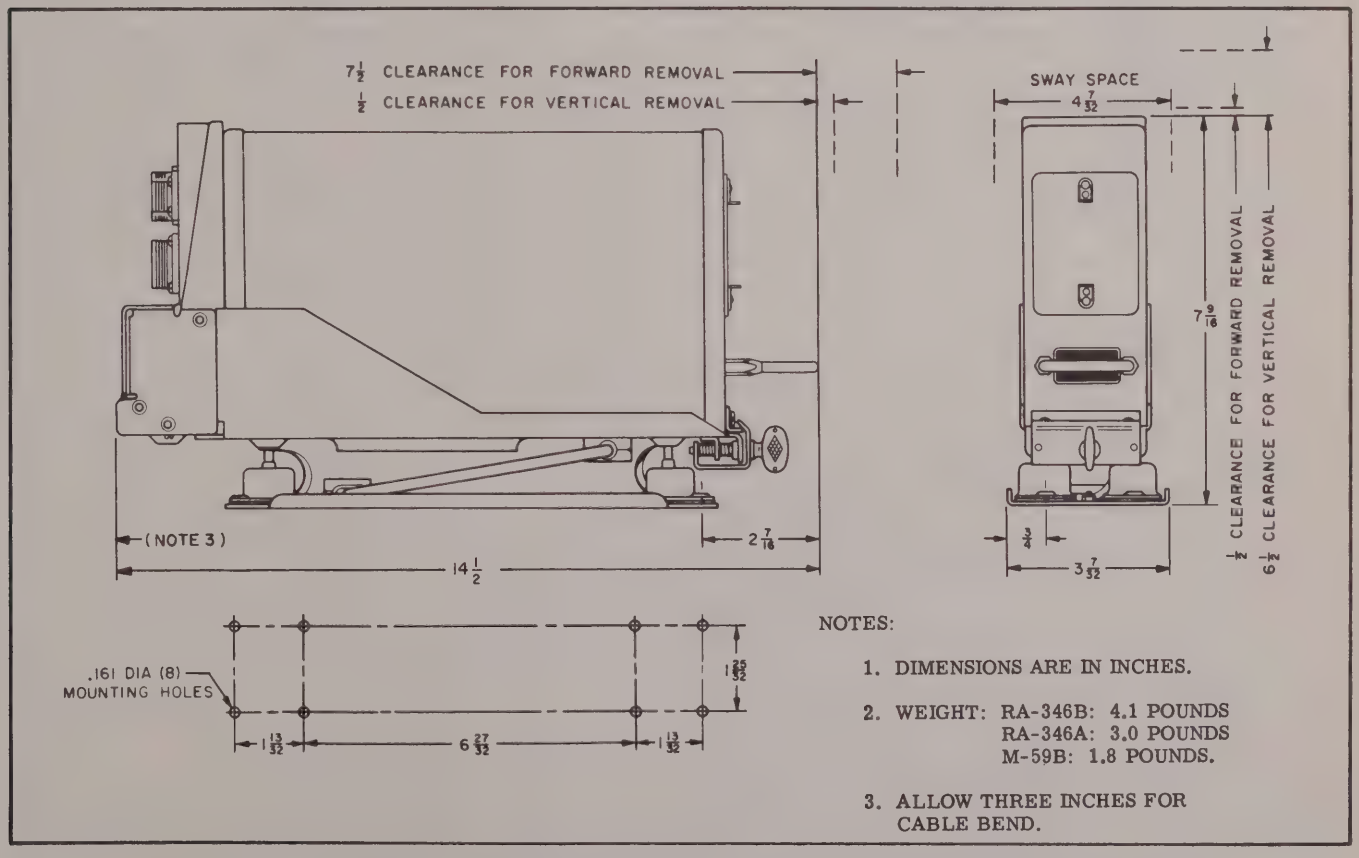
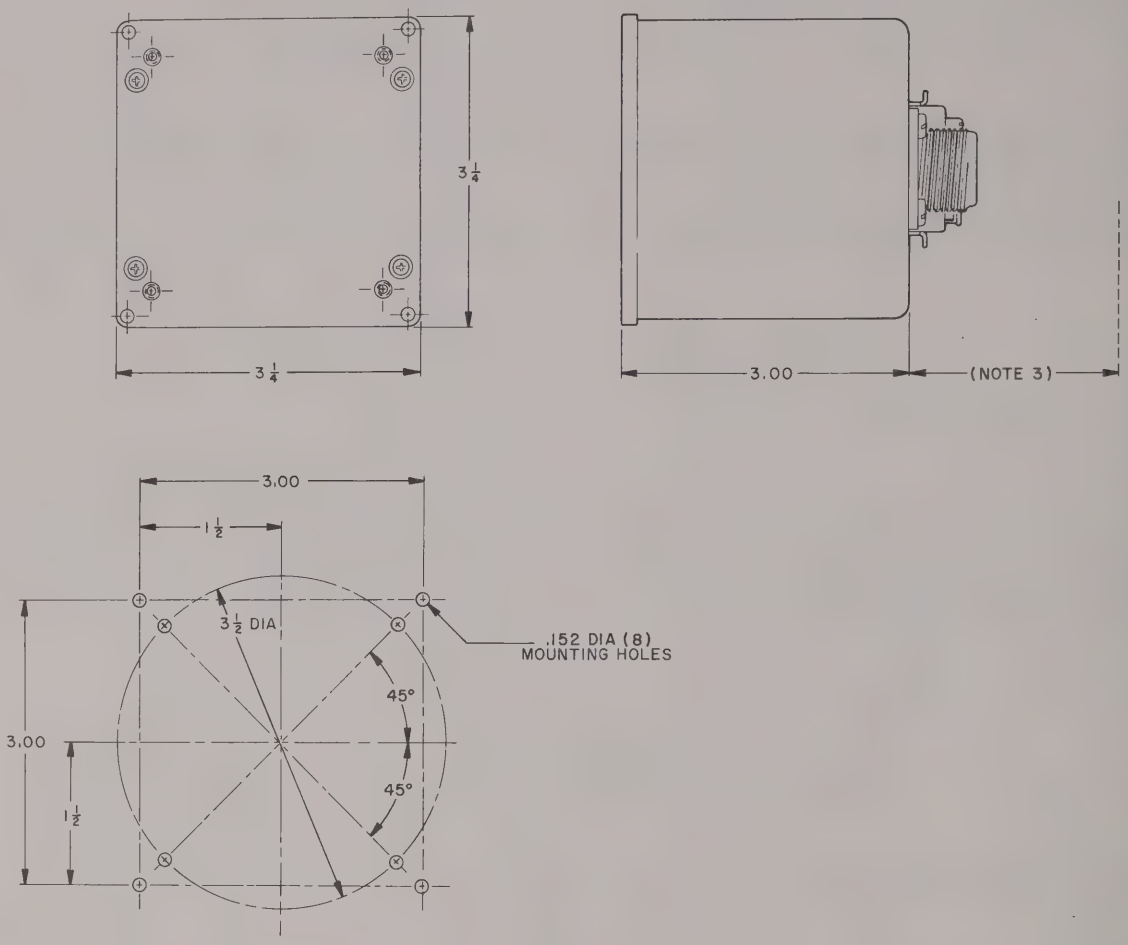


Figure 2-4. RA-346A and RA-346B Receiver Accessory Units, Installation Dimensions



NOTES:

1. DIMENSIONS ARE IN INCHES.
2. WEIGHT: 1.3 POUNDS.
3. ALLOW 3 INCHES FOR PLUG REMOVAL.

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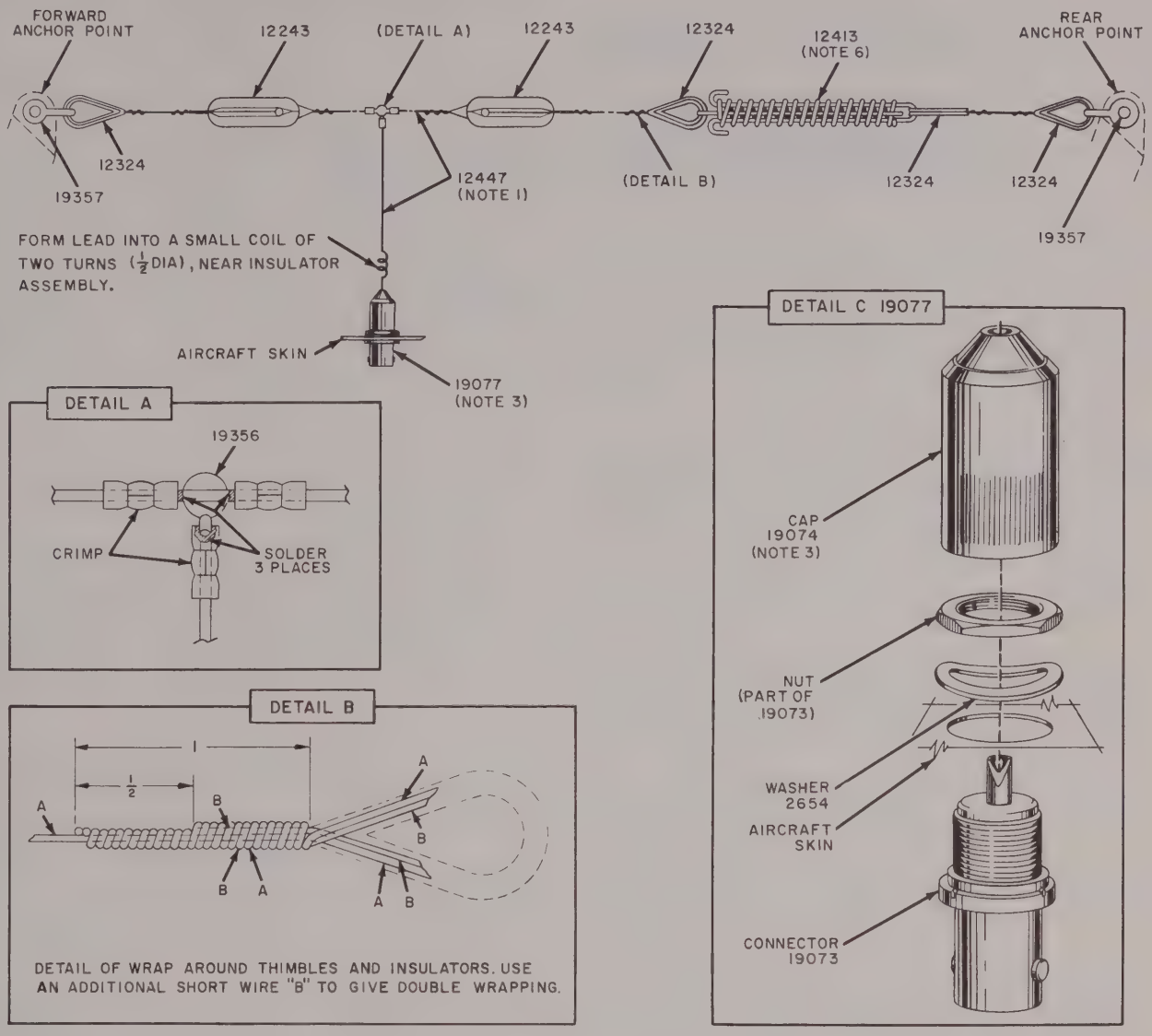
Figure 2-5. RA-446A Receiver Accessory, Installation Dimensions



NOTES:

1. NOMINAL LENGTHS OF WIRE ARE FURNISHED WITH KIT. (ADDITIONAL WIRE MAY BE ORDERED SEPARATELY IN BULK.)
2. WIRES ARE #18AWG SOLID, COPPER-CLAD STEEL.
3. SEE DETAIL "C" FOR INSTALLATION OF INSULATOR ASSEMBLY. SCREW ON CAP AFTER SOLDERING.
4. USE SCREWS AND NUTS FURNISHED TO FASTEN ANTENNA MASTS TO AIRCRAFT.
5. LOCATE VERTICAL SECTION OF ANTENNA AS NEAR THE CENTER OF THE HORIZONTAL SECTION AS POSSIBLE.
6. ADJUST TENSION FOR 3/4-INCH SPRING DEFLECTION; THAT IS, WHEN COMPRESSED, COIL SPRING LENGTH IS 2-5/16 INCHES.

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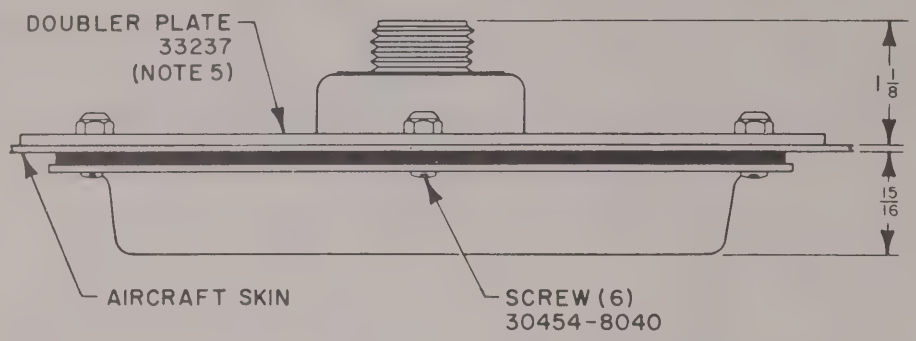
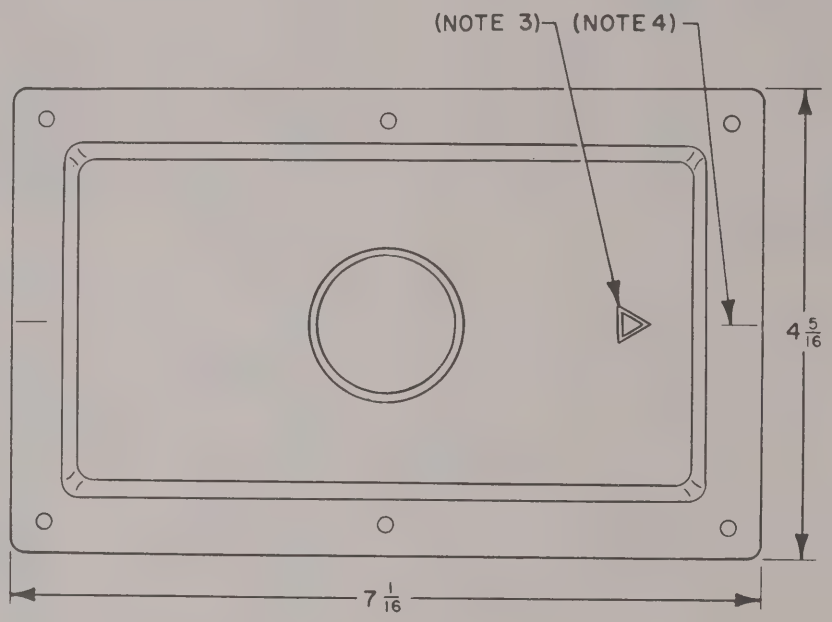
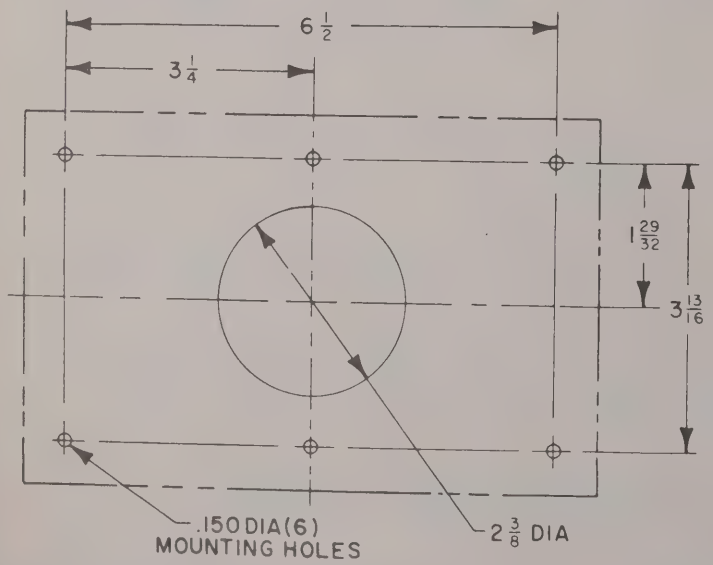
Figure 2-6. Sense Antenna Kit 19210, Installation Diagram







NOTES:

1. DIMENSIONS ARE IN INCHES.
2. WEIGHT:

   L-346A: 1.6 POUNDS;
   DOUBLER PLATE: 0.18 POUND.
3. ARROWHEAD INDICATES FORWARD DIRECTION.
4. LINES ON EDGES INDICATE CENTERLINE.
5. SUPPLIED ON SPECIAL ORDER.

Figure 2-7. L-346A Loop Antenna, Installation Dimensions

Step 4. Loosen flange thumbnut on front of mounting. Slide receiver accessory onto mounting until connectors are fully mated.

Step 5. Position flange on receiver accessory and tighten thumbnut.

Installation dimensions for the RA-446A are shown in Figure 2-5. The unit may be mounted in any position on a bulkhead or other flat surface using suitable hardware. Before installing the RA-446A note the proposed installation locations of the loop and sense antennas, then check the internal wiring connections of the unit for agreement with the antenna locations (see Figure 2-8). Rewire, as necessary, if other than a bottom-mounted loop antenna and a top-mounted sense antenna are to be installed.

2-6. INSTALLATION OF SENSE ANTENNA.

The sense antenna may be fabricated from optional Sense Antenna Kit 19210. General installation requirements are discussed in paragraph 2-2 and are shown in Figure 2-6. The procedure for installing the insulator assembly, which may be ordered as a separate item, is outlined in paragraph 2-7.

2-7. INSTALLATION OF INSULATOR ASSEMBLY.

To install Insulator Assembly 19077 (see detail C of Figure 2-6), proceed as follows:

Step 1. If necessary, place a doubler plate at feed-through location to provide a total thickness of at least 0.040 inch.

Step 2. Drill a 3/8-inch hole through doubler plate and aircraft skin.

Step 3. Mount connector in hole using formed washer and hexagon nut.

Step 4. Slide cap over antenna lead-in. Place lead-in through cross-hole in terminal of connector, and solder so that lead-in is aligned with center of connector.

Step 5. Cut off excess lead-in wires. Screw cap assembly on connector.

2-8. INSTALLATION OF LOOP ANTENNA.

Installation dimensions for the L-346A Loop Antenna are shown in Figure 2-7. To obtain maximum advantage of the 7.5° of fixed compensation in the loop antenna, the final position of the loop should not be determined until after the other units of the 400A ADF have been installed in the aircraft and the following procedure has been performed.

Note

Since this procedure requires operation of the 400A, read Section 3 before proceeding.

Step 1. Interconnect units of the 400A as shown in Figure 2-8, 2-9, or 2-10, routing loop cable (32803 or 33827) through aircraft door or window so that loop antenna may be moved freely.

Step 2. Position aircraft in an area clear of objects which can cause distortion or reflection of received signal.

Step 3. Turn on ADF. Select a radio station, with a known magnetic compass bearing, which is at least 60 miles distant and which operates below 500 kHz.

Step 4. Using a magnetic compass or transit, align centerline of aircraft with known station bearing. Cage DG (directional gyro), adjust to 0°, and uncage.

Step 5. Using DG, turn aircraft to a heading of 315°. (This is a relative bearing of 45° to the station.)

Step 6. Position loop antenna on centerline of aircraft with arrowhead (Figure 2-7) pointing forward; centerline of loop antenna is indicated by index markers on fore and aft edges.

Step 7. Move loop antenna forward and backward along centerline of aircraft until goniometer-indicator indicates as close to 45° as possible.

Step 8. Make certain centerlines of loop antenna and aircraft are aligned, and tape loop antenna to aircraft.

Step 9. Using DG, turn aircraft to a heading of 0° and check that goniometer-indicator indicates 0 ± 5°.

Step 10. If error is greater than ±5°, rotate loop antenna slightly until error is within limits.

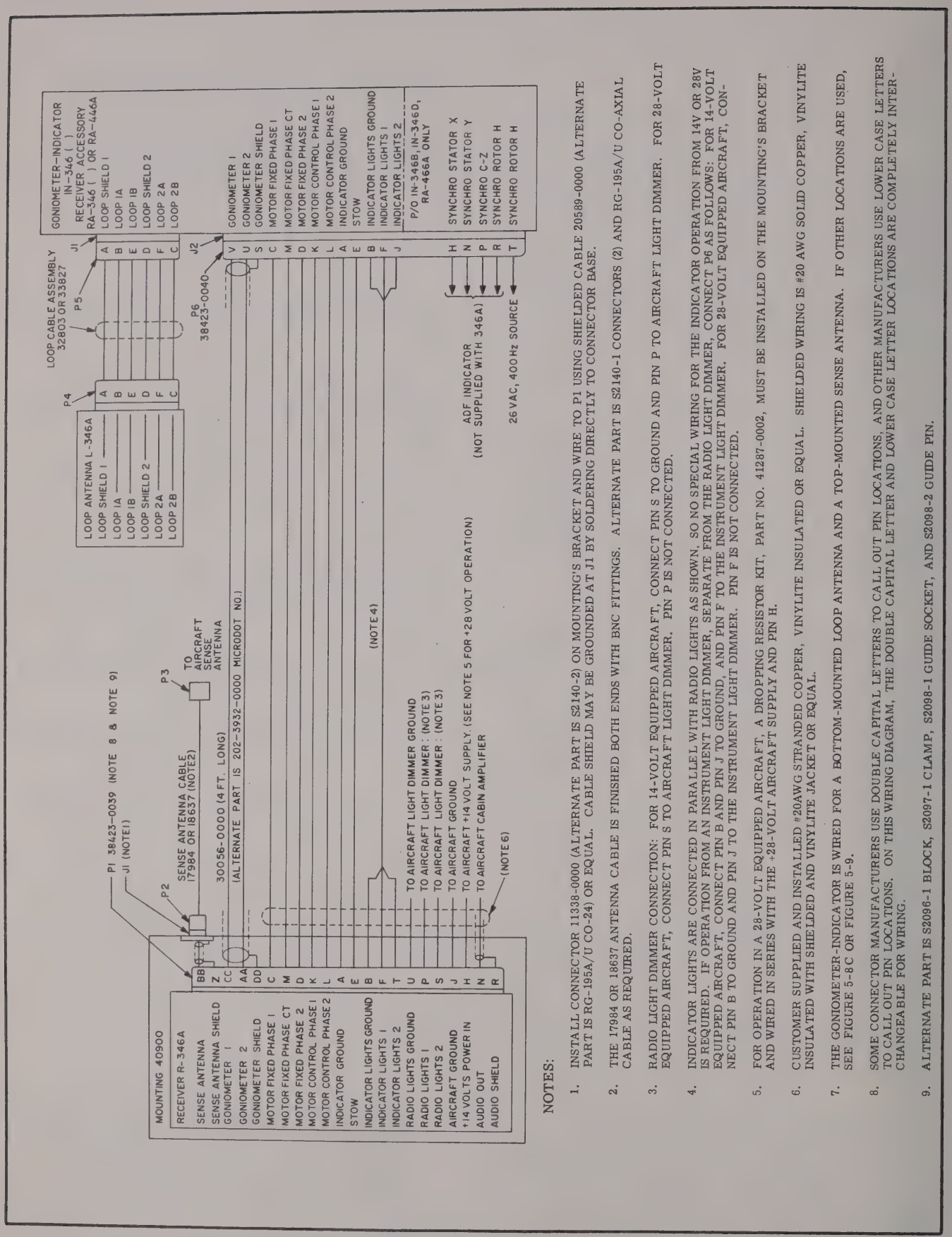
Step 11. Mark final position of loop antenna, remove loop antenna, and drill mounting holes in aircraft skin as shown in Figure 2-7.

Step 12. Using appropriate hardware, secure loop antenna in position.

Note

A doubler plate, such as Part No. 33237 (supplied on special order), may be used to permit the easy removal and reinstallation of the loop antenna. After the required mounting holes for the loop antenna have been drilled, rivet or bolt the doubler plate to the inside surface of the aircraft skin.

Step 13. Reroute loop cable inside aircraft and connect to loop antenna.



NOTES:

1. INSTALL CONNECTOR 11338-0000 (ALTERNATE PART IS S2140-2) ON MOUNTING'S BRACKET AND WIRE TO P1 USING SHIELDED CABLE 20589-0000 (ALTERNATE PART IS RG-195A/U CO-24) OR EQUAL. CABLE SHIELD MAY BE GROUNDED AT J1 BY SOLDERING DIRECTLY TO CONNECTOR BASE.
2. THE 17984 OR 18637 ANTENNA CABLE IS FINISHED BOTH ENDS WITH BNC FITTINGS. ALTERNATE PART IS S2140-1 CONNECTORS (2) AND RG-195A/U CO-AXIAL CABLE AS REQUIRED.
3. RADIO LIGHT DIMMER CONNECTION: FOR 14-VOLT EQUIPPED AIRCRAFT, CONNECT PIN S TO GROUND AND PIN P TO AIRCRAFT LIGHT DIMMER. FOR 28-VOLT EQUIPPED AIRCRAFT, CONNECT PIN S TO AIRCRAFT LIGHT DIMMER. PIN P IS NOT CONNECTED.
4. INDICATOR LIGHTS ARE CONNECTED IN PARALLEL WITH RADIO LIGHTS AS SHOWN, SO NO SPECIAL WIRING FOR THE INDICATOR OPERATION FROM 14V OR 28V IS REQUIRED. IF OPERATION FROM AN INSTRUMENT LIGHT DIMMER, SEPARATE FROM THE RADIO LIGHT DIMMER, CONNECT P6 AS FOLLOWS: FOR 14-VOLT EQUIPPED AIRCRAFT, CONNECT PIN B AND PIN J TO GROUND, AND PIN F TO THE INSTRUMENT LIGHT DIMMER. FOR 28-VOLT EQUIPPED AIRCRAFT, CONNECT PIN B TO GROUND AND PIN J TO THE INSTRUMENT LIGHT DIMMER. PIN F IS NOT CONNECTED.
5. FOR OPERATION IN A 28-VOLT EQUIPPED AIRCRAFT, A DROPPING RESISTOR KIT, PART NO. 41287-0002, MUST BE INSTALLED ON THE MOUNTING'S BRACKET AND WIRED IN SERIES WITH THE +28-VOLT AIRCRAFT SUPPLY AND PIN H.
6. CUSTOMER SUPPLIED AND INSTALLED #20AWG STRANDED COPPER, VINYLITE INSULATED OR EQUAL. SHIELDED WIRING IS #20 AWG SOLID COPPER, VINYLITE INSULATED WITH SHIELDED AND VINYLITE JACKET OR EQUAL.
7. THE GONIOMETER-INDICATOR IS WIRED FOR A BOTTOM-MOUNTED LOOP ANTENNA AND A TOP-MOUNTED SENSE ANTENNA. IF OTHER LOCATIONS ARE USED, SEE FIGURE 5-8C OR FIGURE 5-9.
8. SOME CONNECTOR MANUFACTURERS USE DOUBLE CAPITAL LETTERS TO CALL OUT PIN LOCATIONS, AND OTHER MANUFACTURERS USE LOWER CASE LETTERS TO CALL OUT PIN LOCATIONS. ON THIS WIRING DIAGRAM, THE DOUBLE CAPITAL LETTER AND LOWER CASE LETTER LOCATIONS ARE COMPLETELY INTERCHANGEABLE FOR WIRING.
9. ALTERNATE PART IS S2098-1 BLOCK, S2097-1 CLAMP, S2098-1 GUIDE SOCKET, AND S2098-2 GUIDE PIN.

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Figure 2-8. Cessna 400 ADF with IN-346 ( ) Goniometer-Indicator and/or RA-446A Receiver Accessory, Interconnection Diagram

COLOR OF WIRES BETWEEN PRINTED CIRCUIT BOARD AND CONNECTOR			CONNECTOR PIN NUMBERS			
BASIC COLOR	1ST BAND	2ND BAND	TOP LOOP TOP SENSE	TOP LOOP BOTTOM SENSE	BOTTOM LOOP TOP SENSE	BOTTOM LOOP BOTTOM SENSE
WHT	BLK	GRN	56	56	57	57
WHT	BLK	GY	57	57	56	56
WHT	BLK	RED	54	53	53	54
WHT	BLK	BRN	53	54	54	53

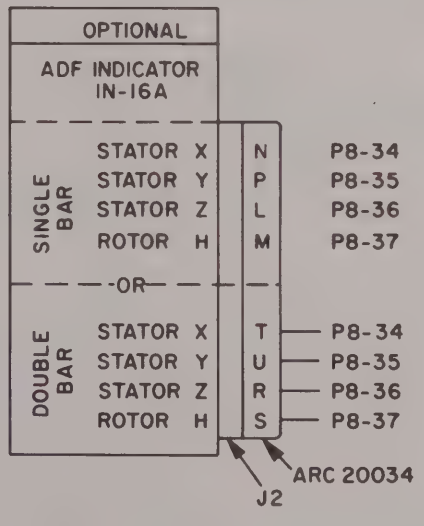
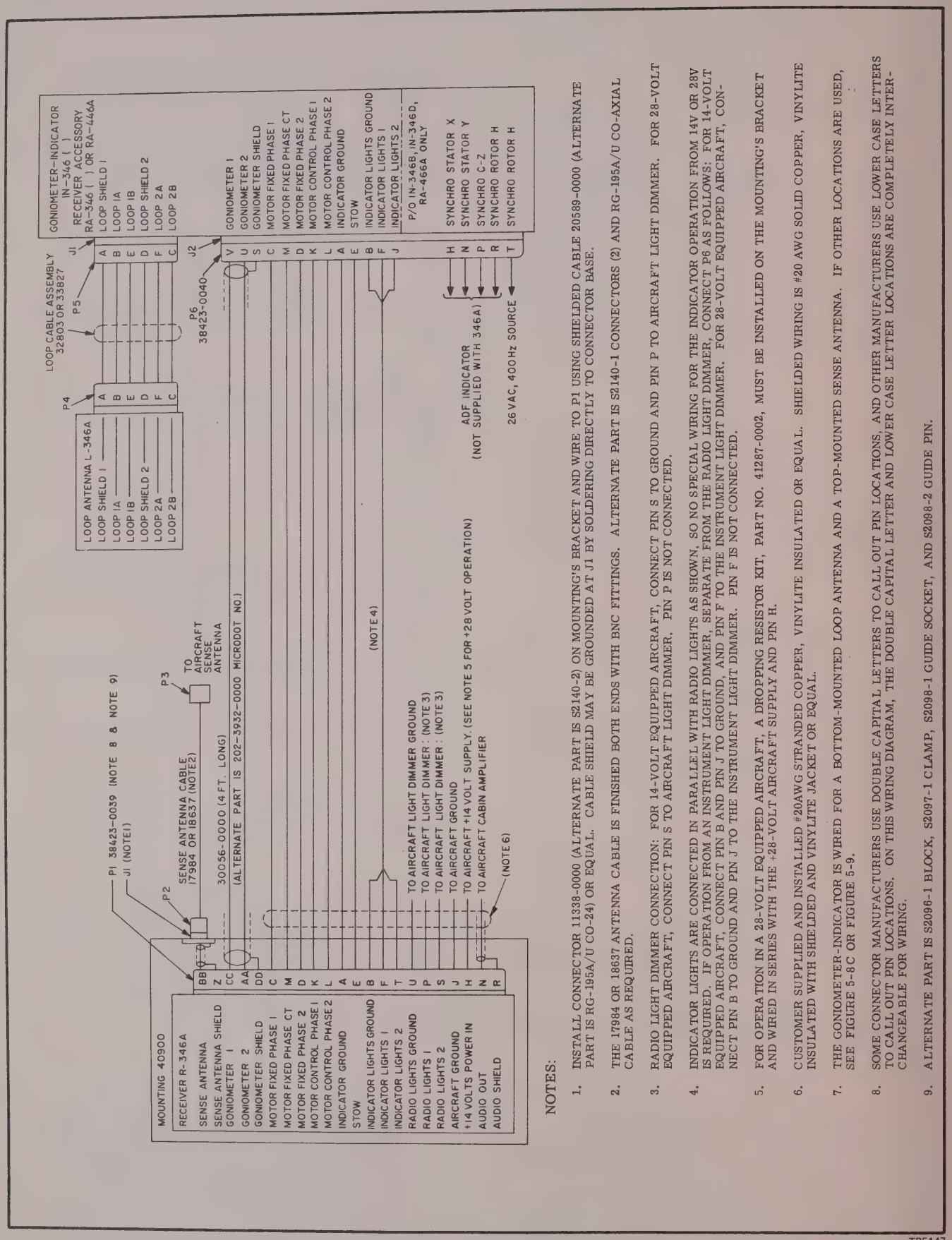


Figure 2-9. Cessna 400 ADF with RA-346A Receiver Accessory, Interconnection Diagram



NOTES:

1. INSTALL CONNECTOR 11338-0000 (ALTERNATE PART IS S2140-2) ON MOUNTING'S BRACKET AND WIRE TO P1 USING SHIELDED CABLE 20589-0000 (ALTERNATE PART IS RG-195A/U CO-24) OR EQUAL. CABLE SHIELD MAY BE GROUNDED AT J1 BY SOLDERING DIRECTLY TO CONNECTOR BASE.
2. THE 17984 OR 18637 ANTENNA CABLE IS FINISHED BOTH ENDS WITH BNC FITTINGS. ALTERNATE PART IS S2140-1 CONNECTORS (2) AND RG-195A/U CO-AXIAL CABLE AS REQUIRED.
3. RADIO LIGHT DIMMER CONNECTION: FOR 14-VOLT EQUIPPED AIRCRAFT, CONNECT PIN S TO GROUND AND PIN P TO AIRCRAFT LIGHT DIMMER. FOR 28-VOLT EQUIPPED AIRCRAFT, CONNECT PIN S TO AIRCRAFT LIGHT DIMMER. PIN P IS NOT CONNECTED.
4. INDICATOR LIGHTS ARE CONNECTED IN PARALLEL WITH RADIO LIGHTS AS SHOWN, SO NO SPECIAL WIRING FOR THE INDICATOR OPERATION FROM 14V OR 28V IS REQUIRED. IF OPERATION FROM AN INSTRUMENT LIGHT DIMMER, SEPARATE FROM THE RADIO LIGHT DIMMER, CONNECT P6 AS FOLLOWS: FOR 14-VOLT EQUIPPED AIRCRAFT, CONNECT PIN B AND PIN J TO GROUND, AND PIN F TO THE INSTRUMENT LIGHT DIMMER. FOR 28-VOLT EQUIPPED AIRCRAFT, CONNECT PIN B TO GROUND AND PIN J TO THE INSTRUMENT LIGHT DIMMER. PIN F IS NOT CONNECTED.
5. FOR OPERATION IN A 28-VOLT EQUIPPED AIRCRAFT, A DROPPING RESISTOR KIT, PART NO. 41287-0002, MUST BE INSTALLED ON THE MOUNTING'S BRACKET AND WIRED IN SERIES WITH THE +28-VOLT AIRCRAFT SUPPLY AND PIN H.
6. CUSTOMER SUPPLIED AND INSTALLED #20AWG STRANDED COPPER, VINYLITE INSULATED OR EQUAL. SHIELDED WIRING IS #20 AWG SOLID COPPER, VINYLITE INSULATED WITH SHIELDED AND VINYLITE JACKET OR EQUAL.
7. THE GONIOMETER-INDICATOR IS WIRED FOR A BOTTOM-MOUNTED LOOP ANTENNA AND A TOP-MOUNTED SENSE ANTENNA. IF OTHER LOCATIONS ARE USED, SEE FIGURE 5-8C OR FIGURE 5-9.
8. SOME CONNECTOR MANUFACTURERS USE DOUBLE CAPITAL LETTERS TO CALL OUT PIN LOCATIONS, AND OTHER MANUFACTURERS USE LOWER CASE LETTERS TO CALL OUT PIN LOCATIONS. ON THIS WIRING DIAGRAM, THE DOUBLE CAPITAL LETTER AND LOWER CASE LETTER LOCATIONS ARE COMPLETELY INTERCHANGEABLE FOR WIRING.
9. ALTERNATE PART IS S2096-1 BLOCK, S2097-1 CLAMP, S2098-1 GUIDE SOCKET, AND S2098-2 GUIDE PIN.

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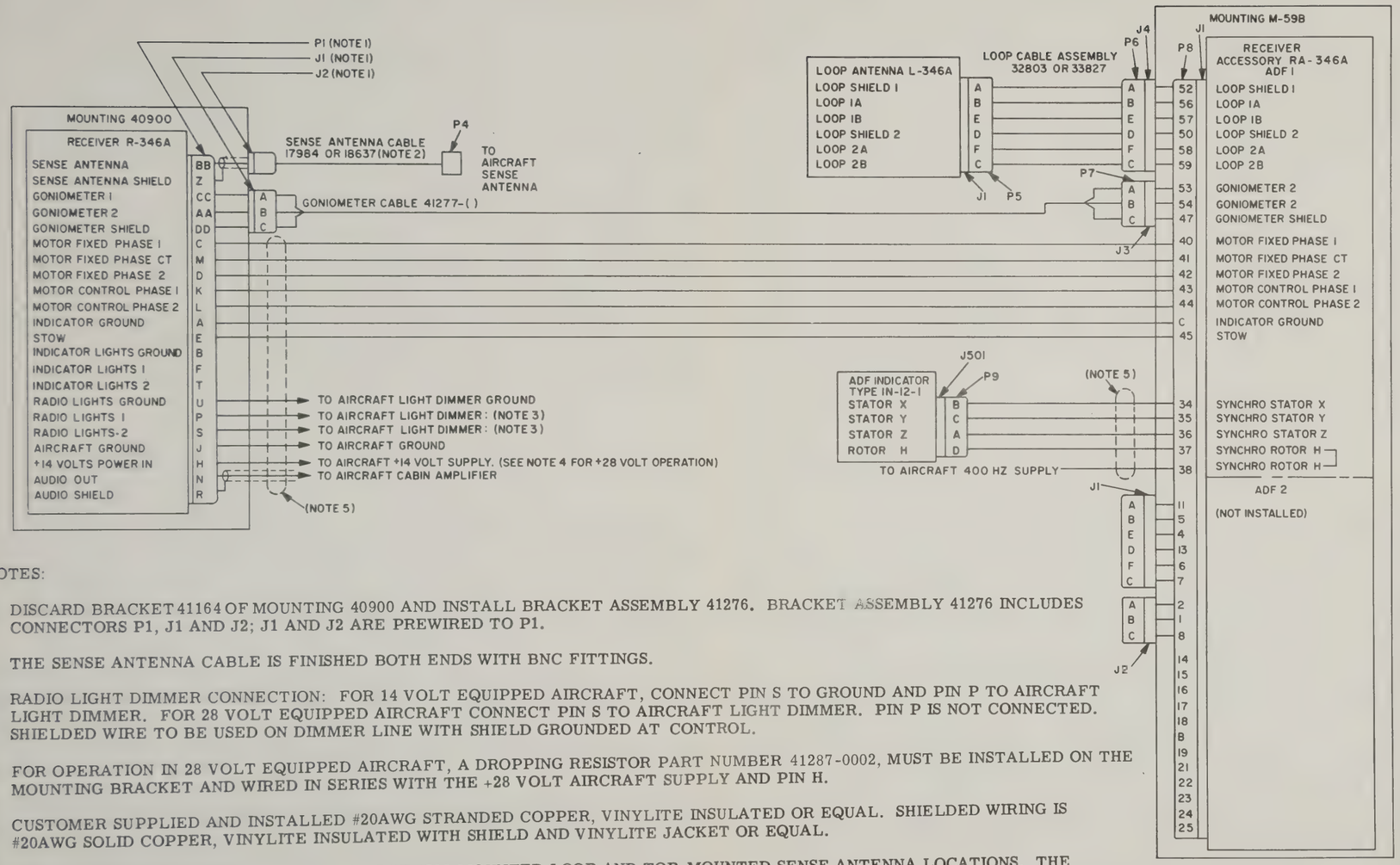
Figure 2-8. Cessna 400 ADF with IN-346 ( ) Goniometer-Indicator and/or RA-446A Receiver Accessory, Interconnection Diagram



NOTES:

1. DISCARD BRACKET 41164 OF MOUNTING 40900 AND INSTALL BRACKET ASSEMBLY 41276. BRACKET ASSEMBLY 41276 INCLUDES CONNECTORS P1, J1 AND J2; J1 AND J2 ARE PREWIRED TO P1.
2. THE SENSE ANTENNA CABLE IS FINISHED BOTH ENDS WITH BNC FITTINGS.
3. RADIO LIGHT DIMMER CONNECTION: FOR 14 VOLT EQUIPPED AIRCRAFT, CONNECT PIN S TO GROUND AND PIN P TO AIRCRAFT LIGHT DIMMER. FOR 28 VOLT EQUIPPED AIRCRAFT CONNECT PIN S TO AIRCRAFT LIGHT DIMMER. PIN P IS NOT CONNECTED. SHIELDED WIRE TO BE USED ON DIMMER LINE WITH SHIELD GROUNDED AT CONTROL.
4. FOR OPERATION IN 28 VOLT EQUIPPED AIRCRAFT, A DROPPING RESISTOR PART NUMBER 41287-0002, MUST BE INSTALLED ON THE MOUNTING BRACKET AND WIRED IN SERIES WITH THE +28 VOLT AIRCRAFT SUPPLY AND PIN H.
5. CUSTOMER SUPPLIED AND INSTALLED #20AWG STRANDED COPPER, VINYLITE INSULATED OR EQUAL. SHIELDED WIRING IS #20AWG SOLID COPPER, VINYLITE INSULATED WITH SHIELD AND VINYLITE JACKET OR EQUAL.
6. THE RA-346A IS INTERNALLY WIRED FOR BOTTOM-MOUNTED LOOP AND TOP-MOUNTED SENSE ANTENNA LOCATIONS. THE CONNECTOR ON THE RA-346A HAS REMOVABLE PINS. (THE PINS MAY BE REMOVED USING ARC TOOL W-11, PART NUMBER 22001-0000.) IF OTHER ANTENNA LOCATIONS ARE USED, REMOVE THE PIN TERMINATING THE WIRE OF THE APPROPRIATE COLOR AS SHOWN IN THE TABLE AND REINSERT AS SPECIFIED. NO SOLDERING OPERATION IS NEEDED.

COLOR OF WIRES BETWEEN PRINTED CIRCUIT BOARD AND CONNECTOR			CONNECTOR PIN NUMBERS			
BASIC COLOR	1ST BAND	2ND BAND	TOP LOOP TOP SENSE	TOP LOOP BOTTOM SENSE	BOTTOM LOOP TOP SENSE	BOTTOM LOOP BOTTOM SENSE
WHT	BLK	GRN	56	56	57	57
WHT	BLK	GY	57	57	56	56
WHT	BLK	RED	54	53	53	54
WHT	BLK	BRN	53	54	54	53

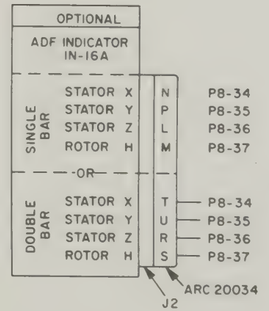


Figure 2-9. Cessna 400 ADF with RA-346A Receiver Accessory, Interconnection Diagram

:ONNECTOR KIT. J2, 11338, IS PART OF 41287-0001,

D BOTH ENDS WITH BNC FITTINGS.

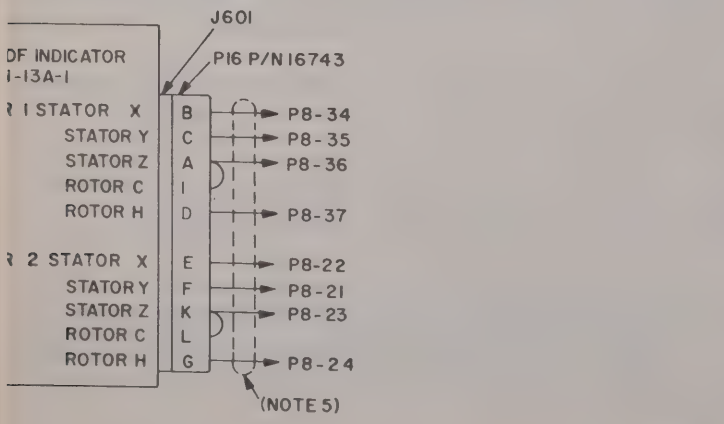
)R 14 VOLT EQUIPPED AIRCRAFT CONNECT PIN S TO
[DIMMER. FOR 28 VOLT EQUIPPED AIRCRAFT
MMER. PIN P IS NOT CONNECTED. SHIELDED WIRE
ELD GROUNDED AT CONTROL.

AIRCRAFT, A DROPPING RESISTOR PART NUMBER
IE MOUNTING'S BRACKET AND WIRED IN SERIES WITH
?IN H.

:20AWG STRANDED COPPER, VINYLITE INSULATED OR
)LID COPPER, VINYLITE INSULATED WITH SHIELD

R BOTTOM-MOUNTED LOOP AND TOP-MOUNTED
NECTOR ON THE RA-346B HAS REMOVABLE PINS.
: TOOL W-11, PART NUMBER 22001-0000.) IF OTHER
VE THE PIN TERMINATING THE WIRE OF THE
: TABLE AND REINSERT AS SPECIFIED. NO SOL-

	CONNECTOR PIN NUMBERS		
	TOP LOOP BOTTOM SENSE	BOTTOM LOOP TOP SENSE	BOTTOM LOOP BOTTOM SENSE
	56 57 53 54	57 56 53 54	57 56 54 53
	5 4 2 1	4 5 2 1	4 5 1 2



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2-9. INTERCONNECTION OF UNITS.

The interconnection of units in a Cessna 400 ADF installation varies with the selected units. An interconnection diagram using an IN-346 ( ) Goniometer-Indicator and RA-446A Receiver Accessory is shown in Figure 2-8. An interconnection diagram using an RA-346A Receiver Accessory is shown in Figure 2-9 and an interconnection diagram using an RA-346B Receiver Accessory is shown in Figure 2-10. Refer to the appropriate illustration and connect the units as shown.

2-10. LOOP COMPENSATION.

Introduction. Structural and electrical parts of the aircraft can cause distortion of the radio field pattern and introduce a quadrantal error which can affect the ADF indicator reading. For this reason, the indicated relative bearing of the station from which a radio signal is received must be checked every 15° to determine whether compensation is required to counteract the error.

The nonsymmetry of the coil windings of the loop antenna provides up to 7.5° of fixed compensation, which is effective with proper installation. Additional compensation may be provided electrically in the IN-346A, IN-346B, and RA-446A, while the IN-346C, IN-346D, RA-346A, and RA-346B include an adjustable, mechanical compensating device. As delivered from the factory, these units are set for 0° compensation.

For electrical compensation, inductors (available in kit form; refer to Table 1-1) are connected in series with one or the other of the goniometer stator coils (one for positive correction, the other for negative correction) which changes the induced voltage in the goniometer. This voltage change varies the angular position of the shaft of the goniometer which, in turn, changes the position of the indicator pointer. For mechanical compensation, a device with adjustable screws is included in the IN-346C, IN-346D, RA-346A, and RA-346B. These screws are used to adjust the shape of a cam, which introduces a difference between the angular position of the goniometer and the angular position of the indicator pointer. For either electrical or mechanical compensation, the angular difference is varied as a function of the goniometer shaft so that the pointer of the indicator always indicates the true angle of arrival of the radio signal, rather than the apparent angle.

To obtain accurate results, compensation should be performed twice: first, after gathering data on the ground; then, after gathering data in flight. The data, whether gathered on the ground or during flight, is used to compute the quadrantal error for the IN-346A, IN-346B, and RA-446A, or to prepare a compensation curve for the IN-346C, IN-346D, RA-346A, and RA-346B.

Note

Do not gather data during the period starting two hours before sunset and ending two hours after sunrise. Also, select a station that is static-clear and operating below 500 kHz.

Ground Data For Loop Compensation. To obtain ground data for loop compensation, proceed as follows:

Step 1. Position aircraft in an area clear of all objects which may cause distortion or reflections of received signal.

Step 2. Select a station having a known magnetic compass bearing. Using a compass or transit, align centerline of aircraft with magnetic bearing of station. Align 0° of dial with index of ADF indicator.

Step 3. If DG is not slaved, set it to 0°. If DG is slaved, determine heading required to produce desired relative bearings.

Step 4. Turn aircraft clockwise through 360°, recording ADF indicator bearing indications every 15° on a form similar to that shown in Figure 2-11 (for electrical compensation), or Figure 2-12 (for mechanical compensation).

Step 5. Repeat Step 4, turning aircraft counterclockwise through 360°.

Flight Data For Loop Compensation. Two methods for obtaining flight data are described in the following paragraphs.

Method 1. The following procedure (see Figure 2-13) requires a fairly linear ground reference landmark, such as a road or a railroad track, directed toward a clear-channel radio station at least 60 miles distant. Possible distortion of the radio field may be caused by certain structures, such as power lines or steel towers, on the route selected. To check whether such distortion exists, crisscross the reference line at various angles, while maintaining fixed courses by means of the DG. If rapid changes in the bearing are noted as the line is crossed, distortion exists. This distortion should be eliminated either by selecting another landmark or by flying at a higher altitude.

Note

Steps 1 through 7 of the procedure may be made over a single point, such as a radio intersection, providing the bearing to the radio station is known. Fly a series of figure eights, always crossing the reference point on a 15° change in heading from the previous course. Record the ADF indicator bearing each time the aircraft crosses the reference point.

Step 1. With aircraft in level flight headed toward radio station, fly reference line at an altitude low enough for accurate determination of position

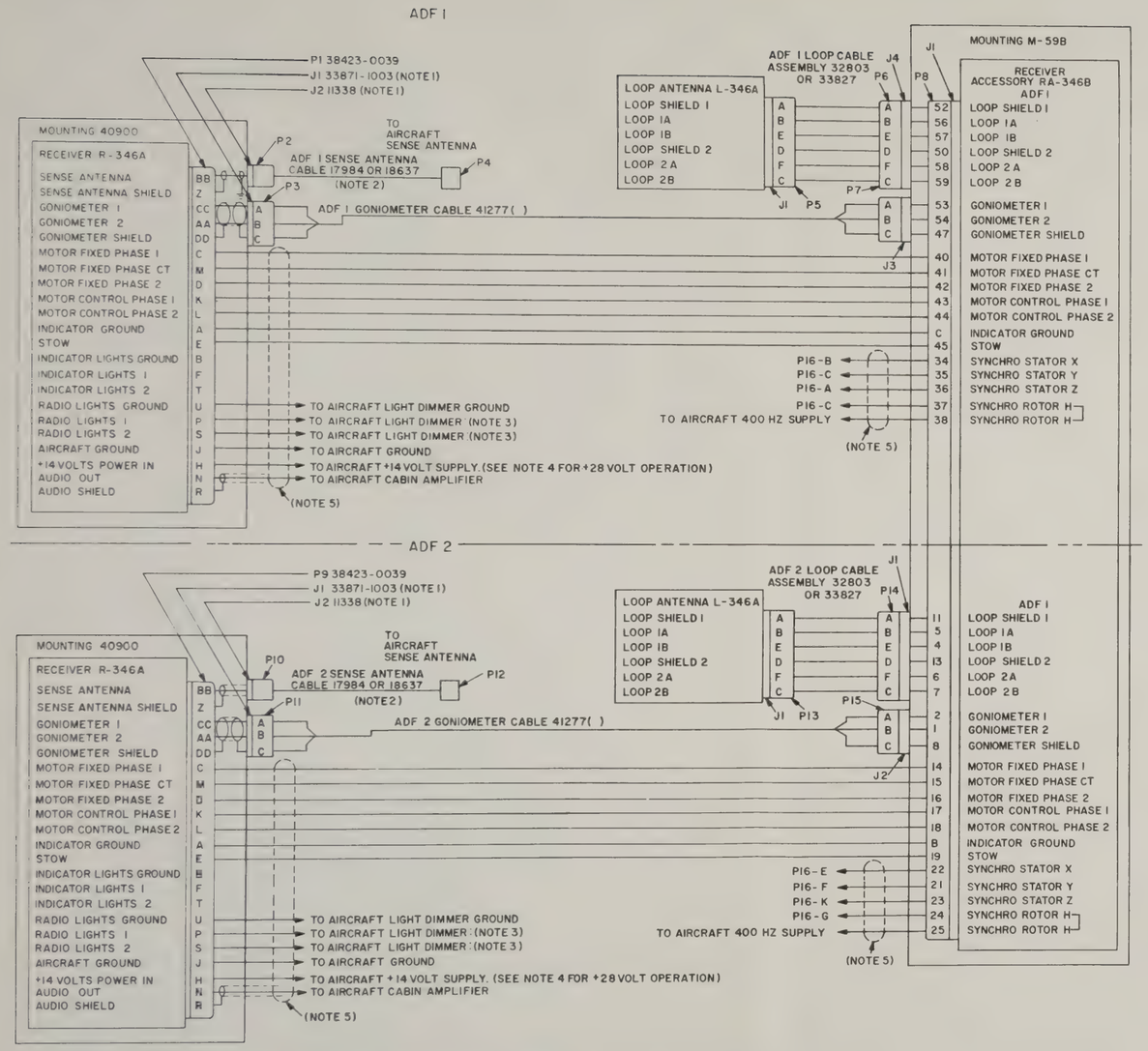
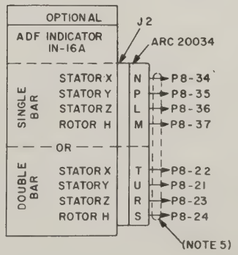


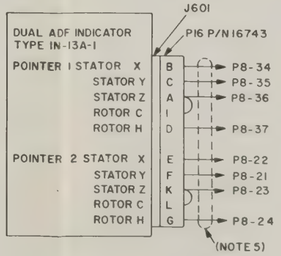
Figure 2-10. Cessna 400 ADF with RA-346B Receiver Accessory, Interconnection Diagram

NOTES:

1. J1, 33871-1003, IS PART OF 41287-0003, CONNECTOR KIT. J2, 11338, IS PART OF 41287-0001, CONNECTOR KIT.
2. THE SENSE ANTENNA CABLE IS FINISHED BOTH ENDS WITH BNC FITTINGS.
3. RADIO LIGHT DIMMER CONNECTION: FOR 14 VOLT EQUIPPED AIRCRAFT CONNECT PIN S TO GROUND AND PIN P TO AIRCRAFT LIGHT DIMMER. FOR 28 VOLT EQUIPPED AIRCRAFT CONNECT PIN S TO AIRCRAFT LIGHT DIMMER. PIN P IS NOT CONNECTED. SHIELDED WIRE TO BE USED ON DIMMER LINE WITH SHIELD GROUNDED AT CONTROL.
4. FOR OPERATION IN 28 VOLT EQUIPPED AIRCRAFT, A DROPPING RESISTOR PART NUMBER 41287-0002, MUST BE INSTALLED ON THE MOUNTING'S BRACKET AND WIRED IN SERIES WITH THE +28 VOLT AIRCRAFT SUPPLY AND PIN H.
5. CUSTOMER SUPPLIED AND INSTALLED #20AWG STRANDED COPPER, VINYLITE INSULATED OR EQUAL. SHIELDED WIRING IS #20AWG SOLID COPPER, VINYLITE INSULATED WITH SHIELD AND VINYLITE JACKET OR EQUAL.
6. THE RA-346B IS INTERNALLY WIRED FOR BOTTOM-MOUNTED LOOP AND TOP-MOUNTED SENSE ANTENNA LOCATIONS. THE CONNECTOR ON THE RA-346B HAS REMOVABLE PINS. (THE PINS MAY BE REMOVED USING ARC TOOL W-11, PART NUMBER 22001-0000.) IF OTHER ANTENNA LOCATIONS ARE USED, REMOVE THE PIN TERMINATING THE WIRE OF THE APPROPRIATE COLOR AS SHOWN IN THE TABLE AND REINSERT AS SPECIFIED. NO SOLDERING OPERATION IS NEEDED.

	COLOR OF WIRE BETWEEN PRINTED CIRCUIT BOARD AND CONNECTOR			CONNECTOR PIN NUMBERS			
	BASIC COLOR	1ST BAND	2ND BAND	TOP LOOP TOP SENSE	TOP LOOP BOTTOM SENSE	BOTTOM LOOP TOP SENSE	BOTTOM LOOP BOTTOM SENSE
ADF 1	WHT	BLK	GRN	56	56	57	57
	WHT	BLK	GRY	57	57	56	56
	WHT	BLK	RED	54	53	53	54
	WHT	BLK	BRN	53	54	54	53
ADF 2	WHT	GRN	----	5	5	4	4
	WHT	GRY	----	4	4	5	5
	WHT	RED	----	1	2	2	1
	WHT	BRN	----	2	1	1	2





TP5339

2-9. INTERCONNECTION OF UNITS.

The interconnection of units in a Cessna 400 ADF installation varies with the selected units. An interconnection diagram using an IN-346 ( ) Goniometer-Indicator and RA-446A Receiver Accessory is shown in Figure 2-8. An interconnection diagram using an RA-346A Receiver Accessory is shown in Figure 2-9 and an interconnection diagram using an RA-346B Receiver Accessory is shown in Figure 2-10. Refer to the appropriate illustration and connect the units as shown.

2-10. LOOP COMPENSATION.

Introduction. Structural and electrical parts of the aircraft can cause distortion of the radio field pattern and introduce a quadrantal error which can affect the ADF indicator reading. For this reason, the indicated relative bearing of the station from which a radio signal is received must be checked every 15° to determine whether compensation is required to counteract the error.

The nonsymmetry of the coil windings of the loop antenna provides up to 7.5° of fixed compensation, which is effective with proper installation. Additional compensation may be provided electrically in the IN-346A, IN-346B, and RA-446A, while the IN-346C, IN-346D, RA-346A, and RA-346B include an adjustable, mechanical compensating device. As delivered from the factory, these units are set for 0° compensation.

For electrical compensation, inductors (available in kit form; refer to Table 1-1) are connected in series with one or the other of the goniometer stator coils (one for positive correction, the other for negative correction) which changes the induced voltage in the goniometer. This voltage change varies the angular position of the shaft of the goniometer which, in turn, changes the position of the indicator pointer. For mechanical compensation, a device with adjustable screws is included in the IN-346C, IN-346D, RA-346A, and RA-346B. These screws are used to adjust the shape of a cam, which introduces a difference between the angular position of the goniometer and the angular position of the indicator pointer. For either electrical or mechanical compensation, the angular difference is varied as a function of the goniometer shaft so that the pointer of the indicator always indicates the true angle of arrival of the radio signal, rather than the apparent angle.

To obtain accurate results, compensation should be performed twice: first, after gathering data on the ground; then, after gathering data in flight. The data, whether gathered on the ground or during flight, is used to compute the quadrantal error for the IN-346A, IN-346B, and RA-446A, or to prepare a compensation curve for the IN-346C, IN-346D, RA-346A, and RA-346B.

Note

Do not gather data during the period starting two hours before sunset and ending two hours after sunrise. Also, select a station that is static-clear and operating below 500 kHz.

Ground Data For Loop Compensation. To obtain ground data for loop compensation, proceed as follows:

Step 1. Position aircraft in an area clear of all objects which may cause distortion or reflections of received signal.

Step 2. Select a station having a known magnetic compass bearing. Using a compass or transit, align centerline of aircraft with magnetic bearing of station. Align 0° of dial with index of ADF indicator.

Step 3. If DG is not slaved, set it to 0°. If DG is slaved, determine heading required to produce desired relative bearings.

Step 4. Turn aircraft clockwise through 360°, recording ADF indicator bearing indications every 15° on a form similar to that shown in Figure 2-11 (for electrical compensation), or Figure 2-12 (for mechanical compensation).

Step 5. Repeat Step 4, turning aircraft counterclockwise through 360°.

Flight Data For Loop Compensation. Two methods for obtaining flight data are described in the following paragraphs.

Method 1. The following procedure (see Figure 2-13) requires a fairly linear ground reference landmark, such as a road or a railroad track, directed toward a clear-channel radio station at least 60 miles distant. Possible distortion of the radio field may be caused by certain structures, such as power lines or steel towers, on the route selected. To check whether such distortion exists, crisscross the reference line at various angles, while maintaining fixed courses by means of the DG. If rapid changes in the bearing are noted as the line is crossed, distortion exists. This distortion should be eliminated either by selecting another landmark or by flying at a higher altitude.

Note

Steps 1 through 7 of the procedure may be made over a single point, such as a radio intersection, providing the bearing to the radio station is known. Fly a series of figure eights, always crossing the reference point on a 15° change in heading from the previous course. Record the ADF indicator bearing each time the aircraft crosses the reference point.

Step 1. With aircraft in level flight headed toward radio station, fly reference line at an altitude low enough for accurate determination of position

FLIGHT DATA FOR LOOP COMPENSATION

Station Used _____ Frequency _____

Pilot _____ Recorder _____

Reference Point _____ Date _____

Aircraft Type _____ Aircraft No. _____

FLIGHT DATA			LOOP COMPENSATION DATA	
Column 1	Column 2	Column 3	Column 4	Column 5
Aircraft Relative Heading	Station Relative Bearing	ADF Indicator Reading	Quadrantal Error	Compensated ADF Indicator Reading
0	360			
15	345			
30	330			
45	315			
60	300			
75	285			
90	270			
105	255			
120	240			
135	225			
150	210			
165	195			
180	180			
195	165			
210	150			
225	135			
240	120			
255	105			
270	90			
285	75			
300	60			
315	45			
330	30			
345	15			
360	0			

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Figure 2-11. Form for Recording Flight Data for Electrical Compensation

FLIGHT DATA FOR LOOP COMPENSATION

Station Used _____ Frequency _____

Pilot _____ Recorder _____

Reference Point _____ Date _____

Aircraft Type _____ Aircraft No. _____

FLIGHT DATA			LOOP COMPENSATION DATA	
Column 1	Column 2	Column 3	Column 4	Column 5
Aircraft Relative Heading	Station Relative Bearing	ADF Indicator Reading	Goniometer Dial Reading	Compensated ADF Indicator Reading
0	360		0	
15	345		345	
30	330		—	
45	315		315	
60	300		—	
75	285		285	
90	270		—	
105	255		255	
120	240		—	
135	225		225	
150	210		—	
165	195		195	
180	180		180	
195	165		165	
210	150		—	
225	135		135	
240	120		—	
255	105		105	
270	90		—	
285	75		75	
300	60		—	
315	45		45	
330	30		—	
345	15		15	
360	0		0	

Figure 2-12. Form for Recording Flight Data for Mechanical Compensation.

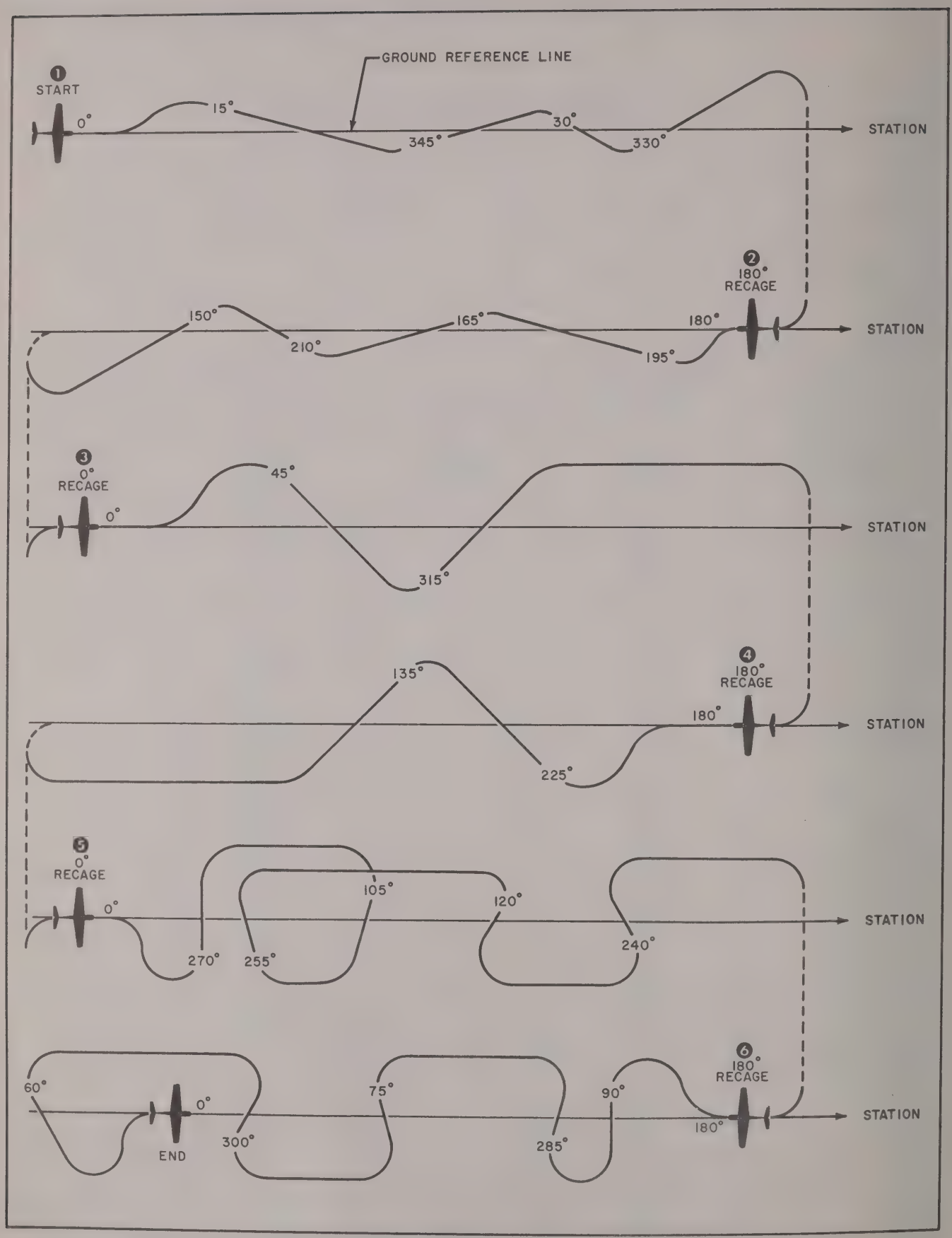


Figure 2-13. Procedure for Obtaining Flight Data for Loop Compensation, Flying Ground Reference Line

and direction. Set DG to 0°. (If aircraft has a slaved gyro, determine heading required to produce desired relative bearings.) Turn VAR or HDG knob to align dial 0° position with index at top of ADF indicator. Turn aircraft to a 0° heading. Record relative bearing indicated by goniometer-indicator pointer on a form similar to that shown in Figure 2-11 or 2-12.

Step 2. Fly a sufficient distance from reference line so that it may be crossed at a heading of 15°. With aircraft held in level flight on a heading of 15°, record relative bearing of ADF indicator when reference line is crossed.

Step 3. Fly sufficiently past reference line so that line may be recrossed at a heading of 345° with aircraft in level flight (see Figure 2-13). Record bearing indication when aircraft crosses reference line.

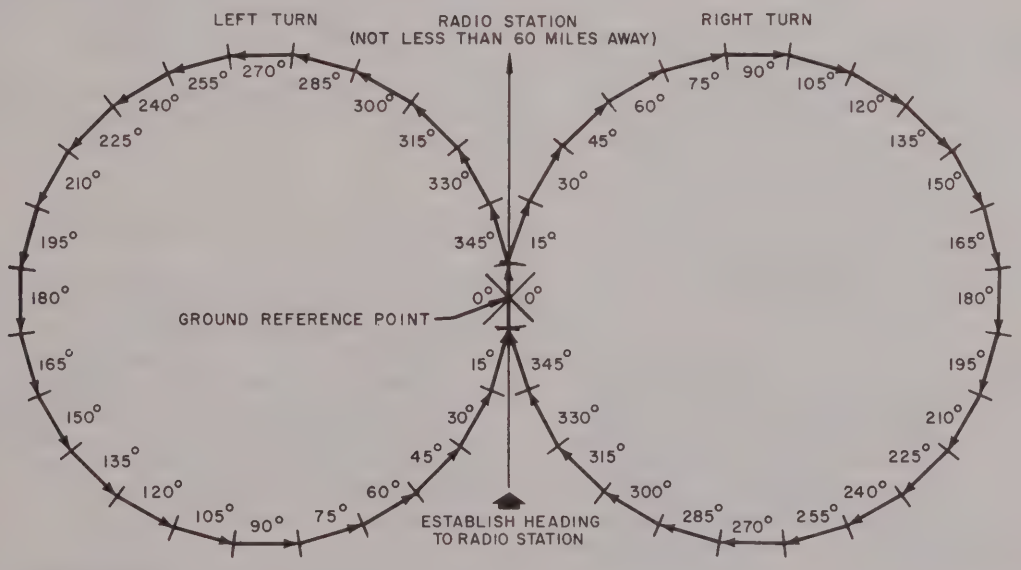
Step 4. Repeat Steps 2 and 3 for headings of 30° and 330°.

Step 5. Turn aircraft to a heading of 180° from radio station and check DG indication when heading of aircraft coincides with reference line. DG indication should be within approximately 2° of a 180° heading if all maneuvers have been made properly. If precession of DG is noted when 180° reference line course is checked, repeat procedure or check DG. Normal creeping of a free DG (2° or less over a period of 15 minutes) may be proportioned to each heading.

Step 6. With aircraft on a 180° heading away from radio station, follow a procedure similar to that outlined previously and obtain ADF indicator bearings for headings of 190°, 165°, 210°, and 150° (see Figure 2-13). Then, turn aircraft to head toward radio station along reference line, establishing a 0° heading with respect to reference line.

Step 7. Continue to fly to and from radio station, crisscrossing reference line, as shown in Figure 2-13, until indicator bearings for every 15° change in heading of aircraft have been recorded. Recorded data will be used for compensation.

Method 2. The following procedure (see Figure 2-14) requires making two 360° flight turns in opposing directions, some distance from a radio station. A landmark, such as a crossroad or a building, is used for a ground reference point from which each circle is started. Disregarding errors introduced by flight conditions or observation procedures, the accuracy of this procedure depends on the distance of the reference point from the radio station and the diameter of the two circles. The ground reference point should be as far as possible from the radio station, but still at a distance where reliable bearing indications can be obtained. The diameter of each circle should be nearly equal so that the error angles at corresponding angles of the turn circles cancel when averaged. The diameters should also be as small as possible, yet large enough so that the flying time during each chord of the circle is sufficient to permit obtaining a reliable indication. As a general recommendation, it is sug-



PROCEDURE:

1. ESTABLISH HEADING.
2. READ INDICATOR BEARING.
3. CHANGE DG HEADING 15 DEGREES AND REPEAT. (ALLOW EQUIVALENT TIME FOR EACH HEADING SO THAT DIAMETERS OF TURNS ARE EQUAL.)

TP1427A

Figure 2-14. Procedure for Obtaining Flight Data for Loop Compensation, Flying Two 360-degree Turns

gested that the distance between the ground reference point and the radio station be at least 60 miles, and that each circle have a maximum diameter of 9 miles. Before the actual flight procedure is begun, it is necessary to correlate the 0° bearing of the goniometer-indicator with the 0° heading of the aircraft. Proceed as follows:

Step 1. Head aircraft directly toward a radio station whose transmitter tower is clearly visible.

Step 2. Tune receiver to station frequency. Adjust VAR or HDG knob to align dial 0° position with index at top of indicator.

Step 3. Using a cross-hair sight which has been aligned accurately with fore-and-aft axis of aircraft, align axis of aircraft with station antenna tower as accurately as possible. If a cross-hair sight is not available, aircraft heading and tower may be aligned by an observer standing aft as far as possible, with a clear line-of-sight through vertical center of windshield, and sighting along centerline of aircraft through center of windshield. Heading checks made directly from cockpit are not reliable because parallax errors may result.

Step 4. With aircraft held in level flight, and headed directly toward station tower, note ADF indicator bearing. To confirm indication obtained, approach station tower from opposite direction and check that ADF indicator bearing is the same. Record ADF indicator bearing obtained for 0° heading of aircraft.

Flight Procedure. With the 0° ADF indicator bearing and the 0° aircraft heading correleated, the flight procedure for Method 2 may be performed (see Figure 2-14). The principle of this procedure is to obtain indications for every 15° change in heading during each of the 360° turns. To approximate a circle as closely as possible, the flying time and speed of each 15° course should be very nearly equal. After each turn has been completed, an ADF indication relative to a given DG indication will be obtained for each turn. Proceed as follows:

Step 1. Select a ground reference point which is not less than 60 miles from radio station to be used. Approach reference point so that it is between aircraft and station. Orient aircraft for a 0° bearing on ADF indicator. If previous flight procedure has established that 0° heading of aircraft does not coincide with 0° bearing of station within ±2°, fly aircraft on heading that corresponds to 0° bearing obtained in preliminary flight procedure.

Step 2. With aircraft held in steady, level flight directly toward station, set DG to 0°. (If a slaved DG is installed in the aircraft, determine the proper heading.) Maintain heading, and when aircraft is over ground reference point, record ADF indicator bearing.

Step 3. Turn aircraft smoothly and evenly to right for a heading of 15°. With aircraft leveled out on this heading for not more than 25 seconds, note and record ADF indicator bearing on a form similar to that shown in Figure 2-11 or 2-12.

Step 4. Turn aircraft to a heading of 30°. After level flight has been resumed, note and record ADF indicator bearing.

Step 5. Follow a similar procedure as outlined in Steps 3 and 4 for each 15° increase in heading of aircraft, until circle-turn is completed. Record ADF indicator bearings for each heading. If turn has been executed properly, aircraft should be over reference point at end of last 15° turn. Turn aircraft for a 0° ADF indicator bearing. Aircraft should now be headed directly toward radio station in line with original starting line. Check relative bearing for this heading; indication should agree with its original setting within 2° to 3° if all turns have been made properly.

Step 6. With aircraft over ground reference point and headed directly toward station, as shown by ADF indication, check that DG indication agrees with its original setting. If not, make a 0° reference check, as outlined in Steps 1 and 2 of this procedure.

Step 7. Start second 360° turn by turning the aircraft to left for a 345° heading. When aircraft is in steady, level flight on this heading, record ADF indicator bearing.

Step 8. Continue circle-turn, until completed, decreasing heading in 15° intervals. Keep diameter of this left turn as equivalent as possible to right turn made previously. Record ADF indicator bearing for each 15° change in heading.

Step 9. Average right-turn and left-turn ADF indicator bearings for each corresponding DG heading.

2-11. ELECTRICAL COMPENSATION.

If the IN-346A, IN-346B, or RA-446A is part of the 400A ADF installation, electrical compensation is used to correct the quadrantal error. In column 4 of Figure 2-11 enter each quadrantal error, which is the difference between the ADF Indicator Reading of Column 3 and the Station Relative Bearing of Column 2. For example, if at a relative bearing of 45° the ADF indicator reads 47°, the quadrantal error is +2°; if the indicator reads 41°, the quadrantal error is -4°.

If it is determined that compensation is required, refer to Figure 2-15 and select the three inductor values required to correct the quadrantal error entered for a 45° relative bearing in Column 4 of Figure 2-11. (The required inductors are available in kit form; refer to Table 1-1.) Connect the inductors as shown in Detail B or Detail C of Figure 2-15. For example, if the quadrantal error is -2°, a positive correction is required. As listed in Figure 2-15, for a +2° correction, L1 and L2 are 1.5 μH and L3 is 470 μH, and the inductors are connected as shown in Detail C.

CAUTION

The connections shown in Figure 2-15 are for a top-mounted sense antenna and a bottom-mounted loop antenna. If other antenna locations are used, which requires that the wiring between terminals be changed (see Figure 2-8), L1 and L2 are connected correspondingly; the connection of L3 is not changed.

2-12. MECHANICAL COMPENSATION.

Preparation of Compensation Data Curve. If the IN-346C or IN-346D, or the RA-346A or RA-346B, is part of the 400A installation, mechanical compensation is used to correct the quadrantal error. After the compensation data has been recorded, the date is plotted and the resulting curve is used to determine the compensation adjustments. For a dual ADF installation, separate curves are prepared for each ADF. Plot the curve as follows:

Step 1. Using a form similar to that shown in Figure 2-16, lay a straight edge parallel to the sloping dotted line and through the data point of Column 3 on the horizontal scale, and draw a fine line (see Figure 2-17). The point at which this line intersects the solid line is the plot point. (The example shown in Figure 2-17 indicates that for an actual bearing of 15°, the ADF indicator bearing is 30°.)

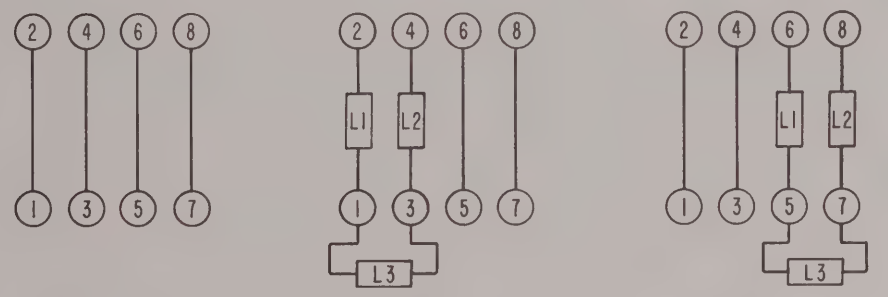
Step 2. Repeat Step 1 for each of the other 15° positions.

Step 3. Connect plot points to form compensation data curve.

Step 4. Determine corrected ADF indicator bearing values for Column 5 of Figure 2-12 (see Figure 2-17 for example) from resulting curve as follows:

a. Draw fine lines parallel to solid lines at intersections of plotted curve and dotted lines corresponding to degree values given in Column 4 of Figure 2-12.

b. In Column 5 of Figure 2-12, record the values for the points of intersection as read on the horizontal graduations beside the 15° dotted line values in Column 4 of Figure 2-12. For example: To determine corrected ADF indicator bearing of 45° (Column 4), lay straight edge parallel to solid line and draw a fine line through intersection of dotted 45° line and curve (see Figure 2-17). This line passes through the horizontal graduations at 63°. This value is recorded in Column 5. Similarly, a bearing of 105° from Column 4 gives a bearing of 100° for Column 5.



—DETAIL A—
CONNECTIONS FOR 0° CORRECTION

—DETAIL B—
CONNECTIONS FOR MINUS CORRECTION

—DETAIL C—
CONNECTIONS FOR PLUS CORRECTION

ADF Indication (Col 3, Fig 2-11)	QE (Col 4, Fig 2-11)	Correction	Inductance (μH)			Connection Detail (See Note)
			L1	L2	L3	
51°	+6°	-6°	3.3	3.3	220	B
49°	+4°	-4°	2.2	2.2	330	B
47°	+2°	-2°	1.5	1.5	470	B
45°	0°	0°	0	0	0	A
43°	-2°	+2°	1.5	1.5	470	C
41°	-4°	+4°	2.2	2.2	330	C
39°	-6°	+6°	3.3	3.3	220	C

NOTE: CONNECTIONS SHOWN ARE FOR A 400 ADF INSTALLATION WITH BOTTOM-MOUNTED LOOP ANTENNA AND TOP-MOUNTED SENSE ANTENNA. IF OTHER ANTENNA LOCATIONS ARE USED, WHICH REQUIRES THAT THE WIRING BETWEEN TERMINALS BE CHANGED (SEE FIGURE 5-8C), L1 and L2 ARE CONNECTED CORRESPONDINGLY; THE CONNECTION OF L3 IS NOT CHANGED.

TP5341

Figure 2-15. Connection Diagram and Inductor Values for Electrical Compensation

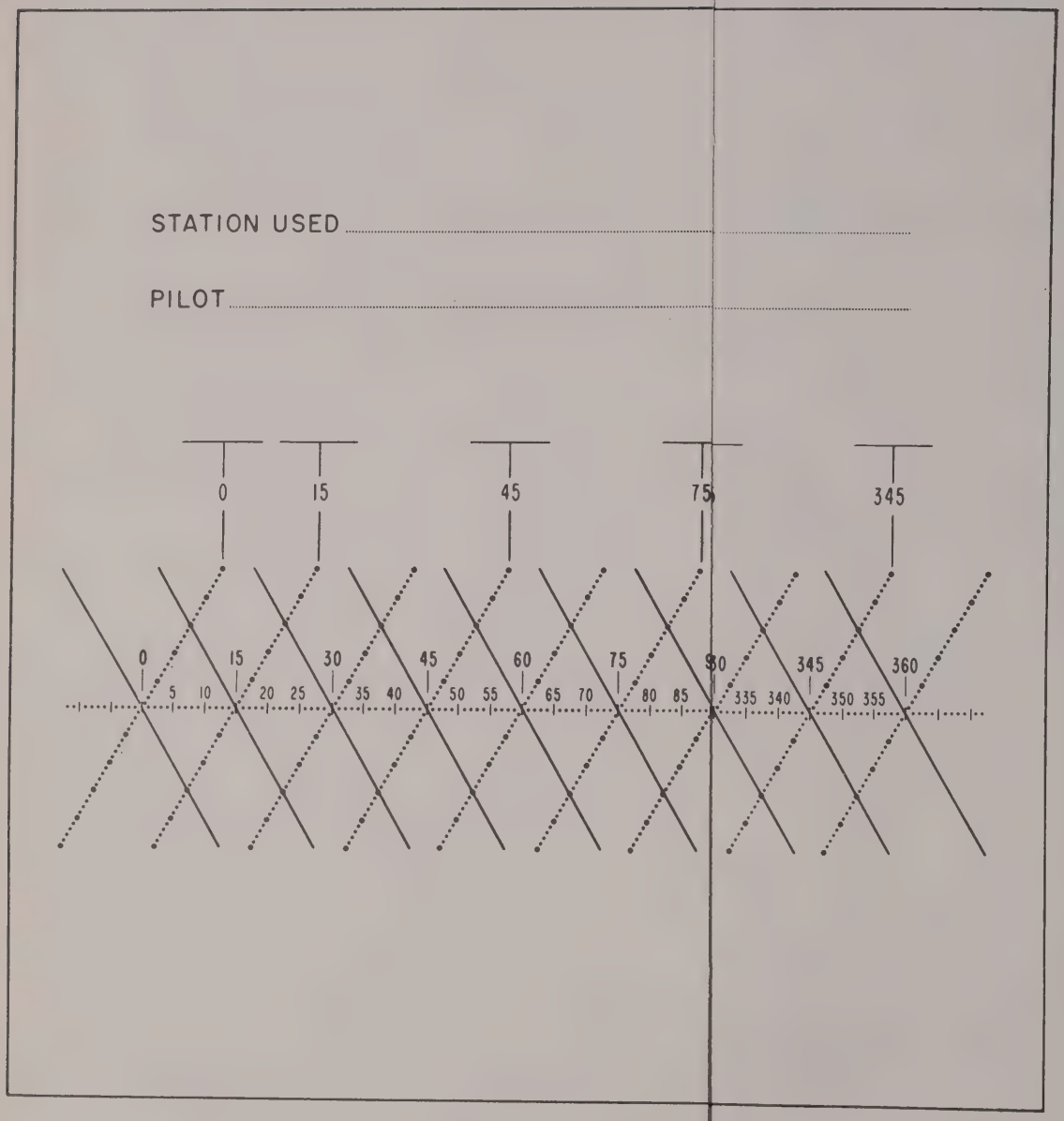


Figure 2-16. Form for Plotting Loop Compensation

FLIGHT DA VE

Station Used ABC — PC AIRFIELD — DATE NOVEMBER 2, 1971

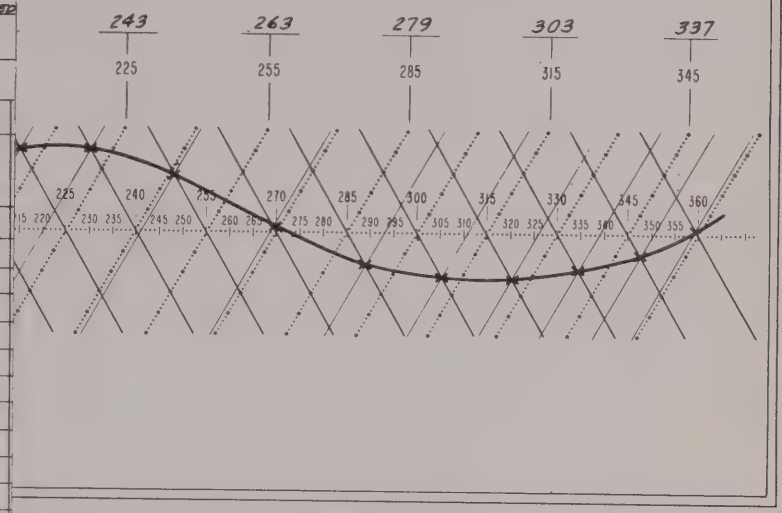
Pilot L.H. NAUMANN — E TYPICAL FIXED WING — AIRCRAFT NO. N12345

Reference Point ARC AIRFIE

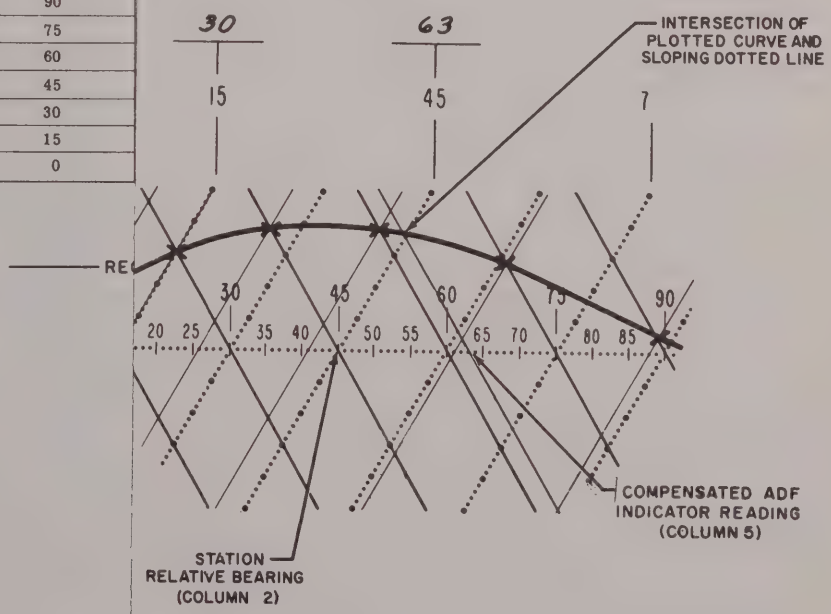
Aircraft Type TYPICAL FIXED

FLIGHT DATA

Column 1	Column 2
Aircraft Relative Heading	Station Relative Bearing
0	360
15	345
30	330
45	315
60	300
75	285
90	270
105	255
120	240
135	225
150	210
165	195
180	180
195	165
210	150
225	135
240	120
255	105
270	90
285	75
300	60
315	45
330	30
345	15
360	0



DETAIL 2



Data and Loop Compensation Curve

LOOP COMPENSATION DATA CURVE

STATION USED ..... FREQUENCY ..... REF POINT ..... DATE .....

PILOT ..... RECORDER ..... AIRCRAFT TYPE ..... AIRCRAFT NO. .....

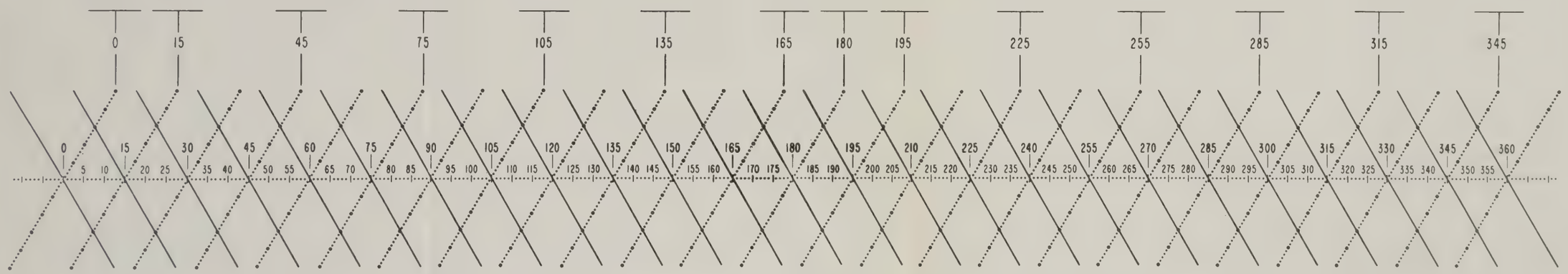


Figure 2-16. Form for Plotting Loop Compensation Data Curve

FLIGHT DATA FOR LOOP COMPENSATION

Station Used ABC — Frequency 330 KC
Pilot L.H. NAUMANN — Recorder F.E. KLENA
Reference Point ARC AIRFIELD — Date NOVEMBER 2, 1971
Aircraft Type TYPICAL FIXED WING — Aircraft No. N12345

FLIGHT DATA			LOOP COMPENSATION DATA	
Column 1	Column 2	Column 3	Column 4	Column 5
Aircraft Relative Heading	Station Relative Bearing	ADF Indicator Reading	Goniometer Dial Reading	Compensated ADF Indicator Reading
0	360	359	0	1
15	345	350	345	337
30	330	339	—	—
45	315	326	315	303
60	300	311	—	—
75	285	293	285	279
90	270	269	—	—
105	255	241	255	263
120	240	220	—	—
135	225	205	225	243
150	210	195	—	—
165	195	186	195	210
180	180	179	180	181
195	165	169	165	159
210	150	158	—	—
225	135	146	135	123
240	120	131	—	—
255	105	112	105	100
270	90	88	—	—
285	75	61	75	83
300	60	41	—	—
315	45	26	45	63
330	30	15	—	—
345	15	7	15	30
360	0	359	0	1

RECORDED FLIGHT DATA

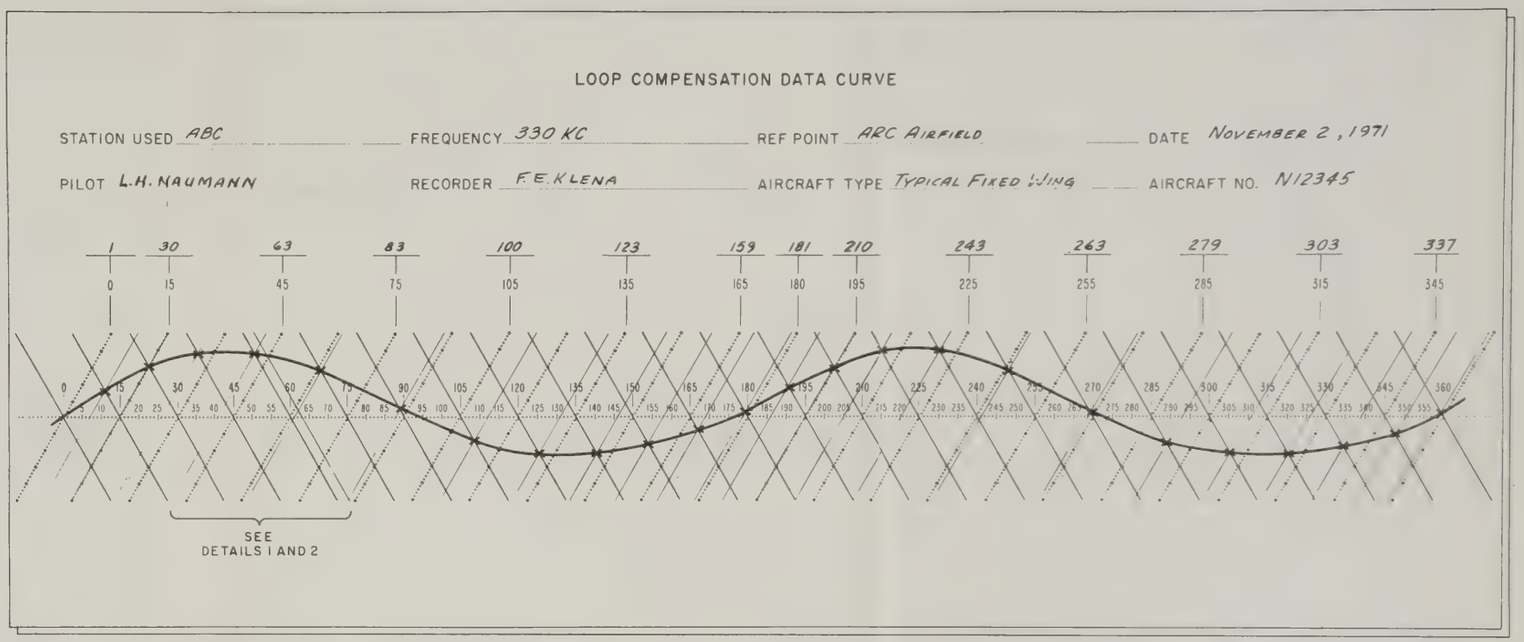


Figure 2-17. Example of Recorded Flight Data and Loop Compensation Curve

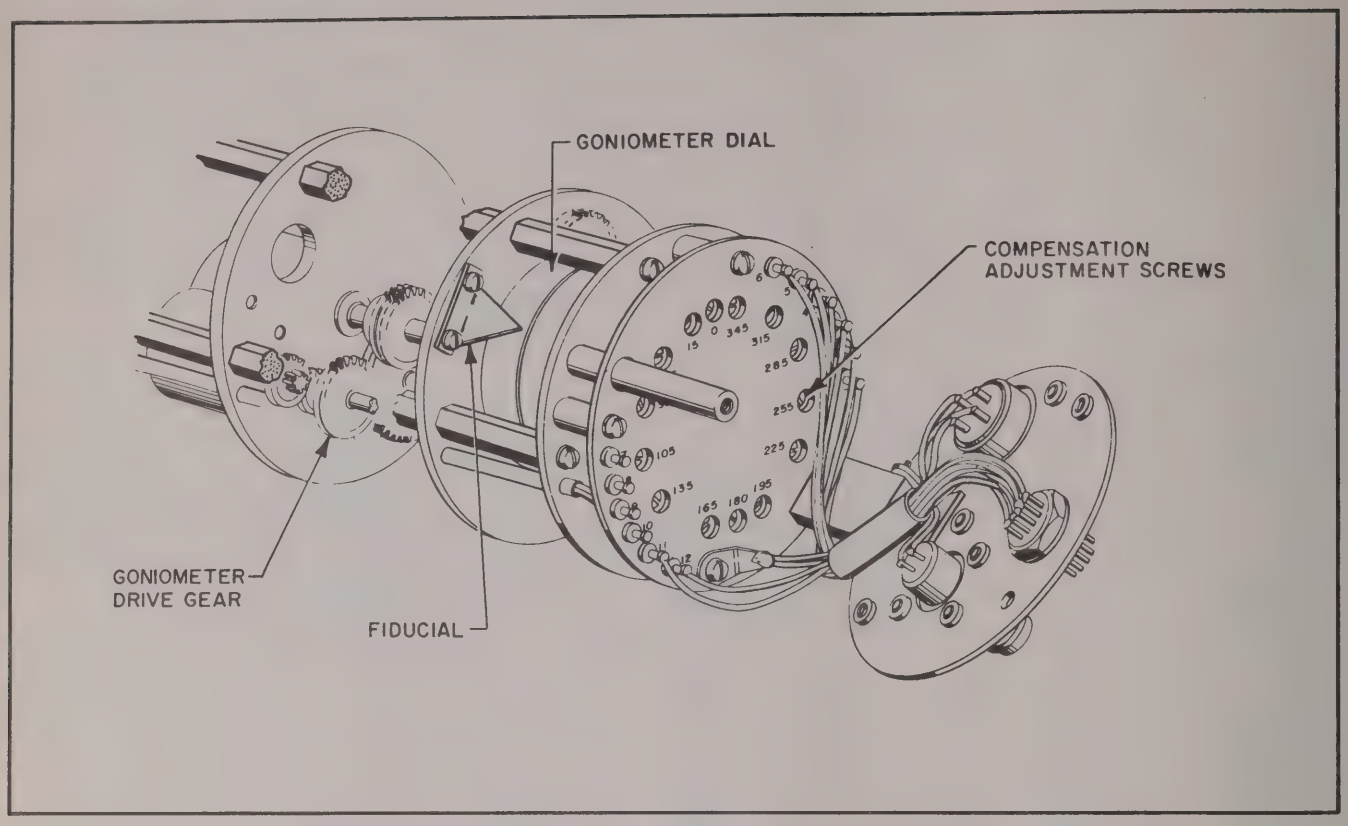


Figure 2-18. IN-346C and IN-346D Goniometer Indicators, Compensation Adjustment Points

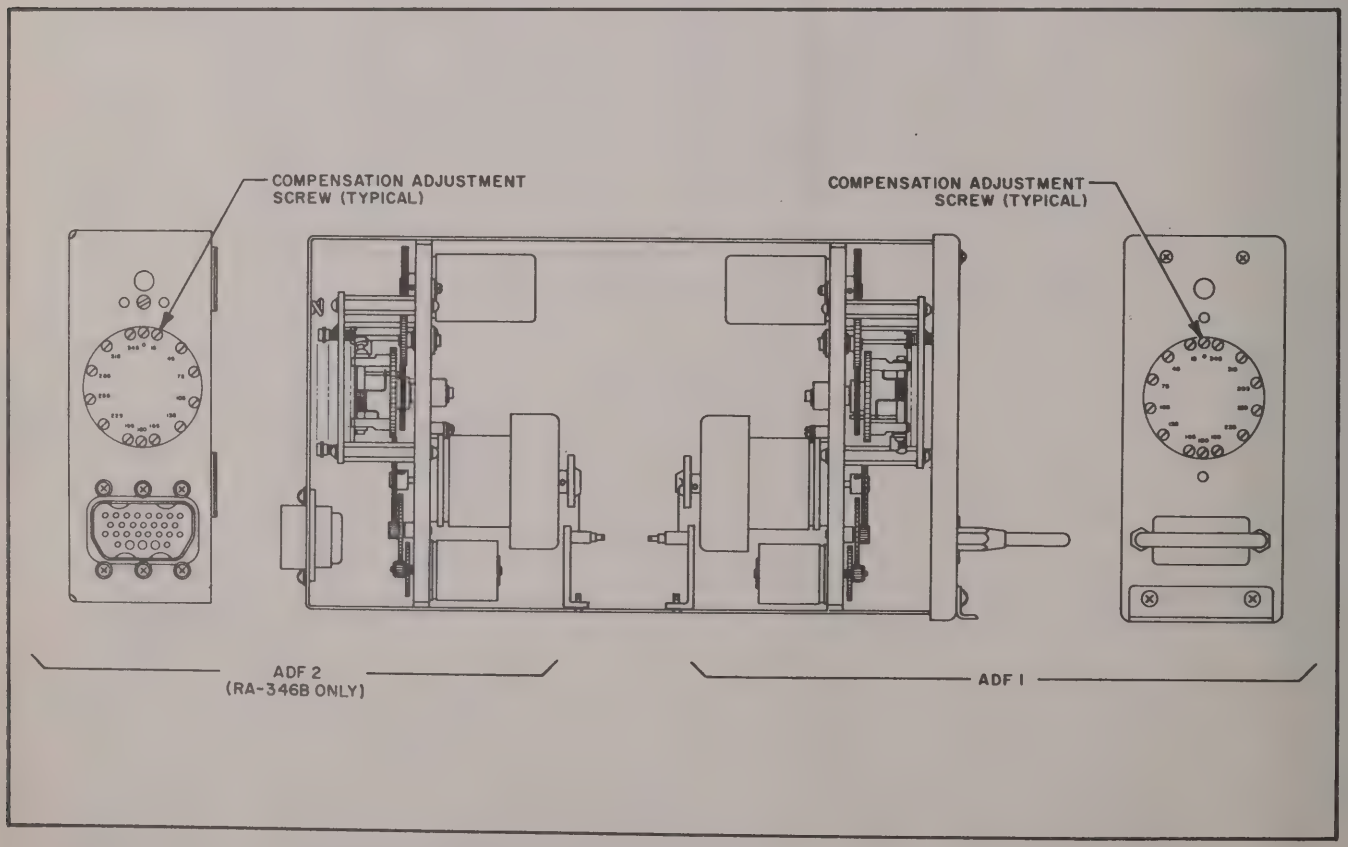


Figure 2-19. RA-346A or RA-346B Receiver Accessory, Compensation Adjustment Points

Goniometer-Indicator Compensation Adjustment. To compensate the IN-346C or IN-346D Goniometer-Indicator, see Figure 2-18, and proceed as follows:

Step 1. Disconnect cables from goniometer-indicator and remove instrument from mounting panel. (Compensation can be performed without power applied to goniometer-indicator.)

Step 2. Remove cover from goniometer-indicator. Remove screw in rear plate and swing hinged, rear plate down.

Step 3. Using VAR knob, align 0° on dial with index.

Step 4. Using goniometer drive gear, align 0° mark on goniometer drum dial with fiducial. Hold goniometer-indicator so that all gears rotate freely.

Step 5. Adjust 0° compensation screw until goniometer-indicator pointer indicates computed value for 0° in Column 5 of Figure 2-12.

CAUTION

Do not force screws. It may appear that the compensation available at a particular point is insufficient to make the indicator read correctly. If this condition occurs, do not force the screw being adjusted, but proceed to set the other screws. When, as required by Step 8, the procedure is repeated, it will be found that sufficient compensation is available from all screws.

Step 6. Using goniometer drive gear, align 15° mark on goniometer dial with fiducial. Adjust 15° compensation screw until goniometer-indicator pointer indicates computed value for 15° in Column 5 of Figure 2-12.

Step 7. Continue adjustment for each screw using computed value in Column 5 of Figure 2-12 for screw being adjusted.

Step 8. Repeat Steps 4 through 7 until satisfactory compensation has been achieved.

Step 9. Reassemble and reinstall goniometer-indicator.

Receiver Accessory Compensation Adjustment. The compensation mechanism in the RA-346A and RA-346B Receiver Accessory is shown in Figure 2-19. The mechanisms in each are identical and the procedure for adjustment is the same. When the rear mechanism in the RA-346B is adjusted, an extension cable is required between the mounting and the RA-346B to provide access to the compensation screws. When performing the adjustment procedures, power must be supplied to the receiver accessory synchro transmitters and the ADF indicator synchro receivers. Power may be obtained by interconnecting the receiver accessory with the associated ADF set and applying power from the receiver. (Set receiver function switch to the REC or ADF position.) Power may also be supplied by connecting the receiver accessory and ADF indicator to a 26-volt, 400-Hz supply. The latter method allows the receiver accessory to be removed from the aircraft for compensation and eliminates the need for an extension cable between the mounting and the RA-346B. Proceed as follows:

Step 1. Remove dust cover from receiver accessory.

Step 2. Interconnect receiver accessory and ADF indicator and apply power.

Step 3. Using VAR knob, align 0° on dial with index on front of ADF indicator.

Step 4. Rotate gears on forward gear assembly and align goniometer drum 0° mark with fiducial.

Step 5. Adjust 0° compensation screw until pointer on ADF indicator indicates computed value for 0° as shown in Column 5 of Figure 2-12.

CAUTION

Do not force screws. In the following procedure, it may appear at first that the compensation available at a particular point is insufficient to make the ADF indicator read correctly. If this occurs, do not force the screw in question, but proceed to set the other screws. When, as required by Step 8, the adjustment procedure is repeated, it will be found that sufficient compensation is available at all adjustment points.

Step 6. Align 15° mark on goniometer dial with fiducial. Adjust 15° compensation screw until ADF pointer indicates computed value for 15° as shown in Column 5 of Figure 2-12.

Step 7. Continue adjustment for each screw using computed value shown in Column 5 of Figure 2-12 for screw being adjusted.

Step 8. Repeat Steps 4 through 7 until satisfactory compensation has been achieved.

Step 9. If RA-346B is being adjusted, repeat procedure (Steps 1 through 8) for other compensating mechanism.

Step 10. Disconnect power, replace dust cover, and install receiver accessory and ADF indicator in aircraft.

SECTION III

OPERATION

3-1. GENERAL.

This section defines the functions of the operating controls and indicators for the Cessna 400 ADF and outlines the general operating procedure. Detailed operating procedures are described and illustrated in the owner's manual.

3-2. OPERATING CONTROLS AND INDICATORS.

Receiver. Except for the HDG or VAR control on the goniometer-indicator (and the optional IN-12-1 and IN-13A-1 Indicators), all operating controls for the Cessna 400 ADF are located on the front panel of the receiver, shown in Figure 3-1. The functions of these controls are as follows:

1. FREQUENCY SELECTORS - Knob (A) selects 100-kHz increments of receiver frequency, knob (B) selects 10-kHz increments, and knob (C) selects 1-kHz increments.
2. VOL - Controls audio output level.
3. OFF - Pushed in: Disconnects primary power, except to receiver panel lamps. Primary power is connected when any other pushbutton, except TEST, is pushed in, which automatically releases OFF button.
4. ADF - Pushed in: Set operates as automatic direction finder using loop and sense antennas.
5. REC - Pushed in: Set operates as communication receiver using only sense antenna.
6. BFO - Pushed in: Set operates as communication receiver using only sense antenna and activates 1000-Hz tone beat frequency oscillator to permit identification of keyed CW signals.
7. TEST - Momentary-on switch used only with ADF function to test bearing reliability. When held depressed, slews indicator pointer; when released, if bearing is reliable, pointer returns to original position. (See CAUTION at top of page.)

CAUTION

Except for TEST button, function selector buttons must be completely depressed and locked in position to activate function selected. Partial depression may release all buttons and disconnect primary power.

Goniometer-Indicator. In addition to the VAR control, which rotates the dial, the goniometer-indicator (and the optional IN-12-1 and IN-13A Indicators) includes a fixed index and a pointer, shown in Figure 3-1. The functions of the control and the indicators are as follows:

1. HDG or VAR - Rotates dial to introduce relative, magnetic, or true bearing information.
2. INDEX - When HDG or VAR control is adjusted, indicates relative, magnetic, or true heading of aircraft.
3. POINTER - When HDG or VAR control is adjusted, indicates relative, magnetic, or true bearing of station from which radio signal is being received. In REC or BFO mode of operation, pointer is automatically stowed at 3 o'clock (90-degree) position.

3-3. OPERATING PROCEDURE.

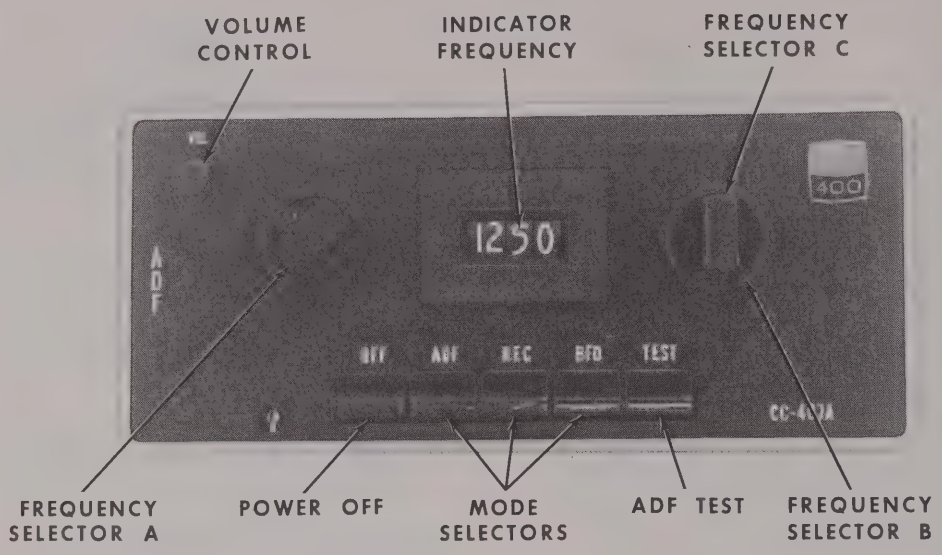
Step 1. Turn set on and select operating mode by pushing in ADF, REC, or BFO pushbutton.

Step 2. Select operating frequency by rotating frequency selector knobs until frequency is displayed digitally.

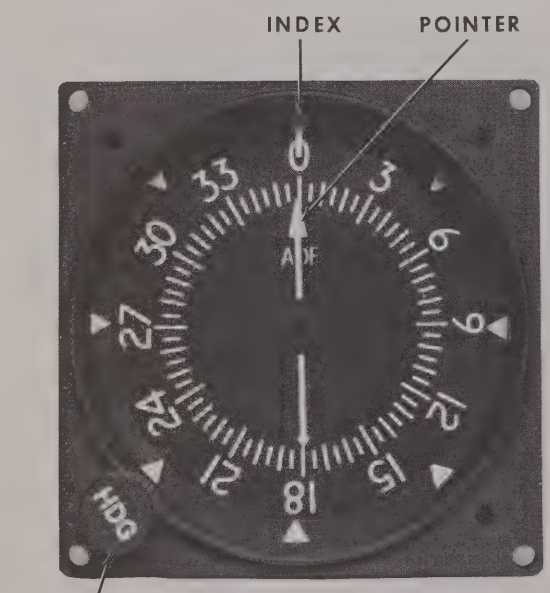
Step 3. Adjust VOL control for desired audio level.

Step 4. In ADF mode of operation, to check bearing reliability, push in and hold TEST button until pointer slews off indicated bearing. Release pushbutton; pointer will return to original position if signal is reliable.

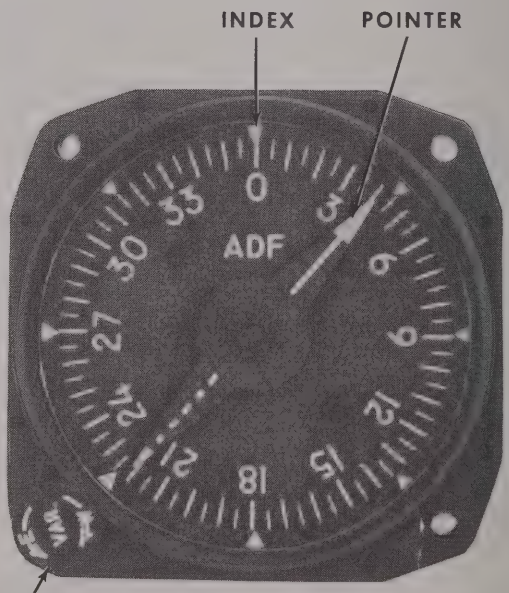
SHOP NOTES:



R-346A RECEIVER



IN-346A GONIOMETER-INDICATOR



IN-346C GONIOMETER-INDICATOR

Figure 3-1. Cessna 400 ADF, Operating Controls and Indicators

SECTION IV

MAINTENANCE

4-1. INTRODUCTION.

This section contains maintenance information for the Cessna 400 ADF. It includes a list of required test equipment and accessories, removal and replacement procedures, performance checks, alignment and adjustment procedures, and typical measurements.

Schematic and wiring diagrams are included in Section V. Voltage and applicable waveform data are included on the overall schematic diagram, Figure 5-1. Photographs of the assemblies are also included in Section V to assist the technician in component location.

Exploded views of the receiver, goniometer-indicator, and receiver accessory are included in Section VI. Complete parts lists are also included in Section VI.

4-2. TEST EQUIPMENT AND ACCESSORIES.

Table 4-1 lists the recommended test equipment and accessories that are required for maintenance. Equivalent test equipment and accessories may be substituted. Use of either the SA-40C Antenna Position Simulator or a calibrated shielded room is required.

If a calibrated shielded room[1] is used, provision must be made for the sense antenna input to the receiver. For this purpose, an rf capacitive line divider must be connected between the signal generator, which energizes the shielded room radiating wire, and the sense antenna cable. This line divider must have an attenuation of 4:1 for 1/4-meter effective height times the shielded room field attenuation factor[2] and, in addition, must have an output capacitance of 50 pF. An r-f line divider for a shielded room and a table listing the capacitor values for several room factors are shown in Figure 4-1. The addition of a 50 pF dummy antenna capacitor and a DPDT switch as a function selector switch provides a convenient method of selecting either the communication (ANT) or ADF (COMP) signal input for the receiver.

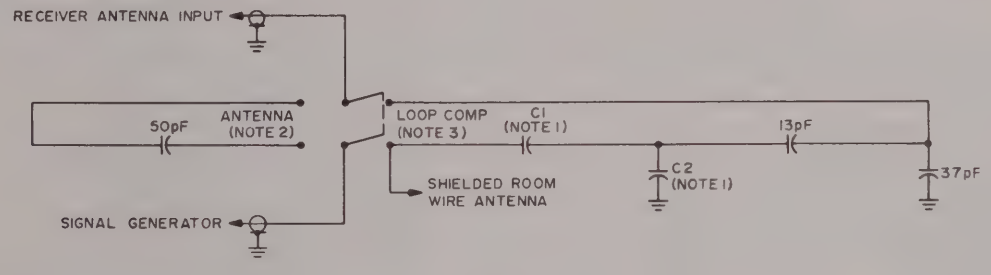
4-3. REMOVAL OF CONTROL ASSEMBLY A9.

To remove control assembly A9 from the receiver, proceed as follows:

Step 1. Loosen two setscrews (3, Figure 6-1) and remove knob (2). Loosen two setscrews (6), one setscrew (8), and remove knobs (5 and 7). Loosen four setscrews (10) and remove two knobs (9).

[1] The construction and calibration of a suitable shielded room is described in Radio Technical Commission for Aeronautics paper 85-56/DO-70, RTCA Secretariat, 1717 H Street, N. W., Washington, D.C. 20006.

[2] Shielded room attenuation factor = $\frac{\text{signal generator output (uV)}}{\text{field strength (uV/meter)}}$



NOTES:

1. TO DETERMINE VALUE OF C1 AND C2 (IN pF) FOR ANY ROOM FACTOR, USE THE FOLLOWING FORMULA.

$$\text{ROOM FACTOR} = \frac{C1 + C2}{C1}$$

FOR KNOWN ATTENUATION RATIOS, THE FOLLOWING CHART MAY BE USED.

ROOM FACTOR	10:1	9:1	8:1	7:1	6:1	5:1	4:1	3:1
C1 (pF)	100	100	100	100	100	100	100	100
C2 (pF)	900	800	700	600	500	400	300	200

2. IN ANT POSITION, THE SIGNAL GENERATOR INDICATES THE ANTENNA OPEN-CIRCUIT MICROVOLTS DIRECTLY.
3. IN COMP POSITION, THE SIGNAL GENERATOR OUTPUT DIVIDED BY THE ROOM FACTOR IS EQUAL TO MICROVOLTS/METER FIELD STRENGTH.

Figure 4-1. Capacitive Line Divider for Shielded Room

Step 2. Remove four screws (21) and remove bezel (20) with printed panel (15) and plate (16) attached.

Step 3. Remove six screws (23) and remove top cover (22). Remove six screws (25) and remove bottom cover (24).

Step 4. Remove four screws (39). Tag and disconnect wires from the chassis assembly and separate control assembly A9 (38) from the main chassis assembly.

Step 5. To replace control assembly A9, reverse the procedures of Steps 1 through 4.

If it is necessary to disassemble the control assembly A9 (38, Figure 6-1), see Figure 6-2 and its associated parts list in Section VI. Except for attaching parts, which are listed after the part they attach, parts are listed and index numbered in a recommended order of disassembly.

4-4. REMOVAL OF LOOP MODULE A1.

To remove loop module A1 (31, Figure 6-1) from receiver assembly, proceed as follows:

Step 1. Remove one screw (29), one lockwasher (30), and spacer (28).

Step 2. Tag and disconnect wiring. Insert a screwdriver blade, or similar blunt tool, into the notch at each end of the board and pry up slightly to free assembly, then carefully remove loop module A1 (31).

Step 3. Reinstall loop module A1 (31) in reverse order.

4-5. REMOVAL OF ASSEMBLIES A2 THROUGH A7.

To remove assemblies A2 through A7 (32 through 37, Figure 6-1,) proceed as follows:

Step 1. Remove four screws (27) and two spacers (26).

Step 2. Insert a screwdriver, or similar blunt tool, into the notch at each end of the board and pry up slightly to free the assembly, then carefully pull assemblies A2 through A7 (32 through 37) straight up.

Step 3. Reinstall assemblies A2 through A7 in reverse order of removal.

4-6. REPLACEMENT OF PARTS IN GONIOMETER-INDICATOR AND RECEIVER ACCESSORY.

To replace parts in the goniometer-indicator or the receiver accessory, refer to the applicable exploded view and associated parts list in Section VI. Except for attaching parts, which are listed after the part they attach, parts are listed and index numbered in a recommended order of disassembly.

4-7. PERFORMANCE CHECKS.

General. Procedures for checking the performance of the Cessna 400 ADF are given in Table 4-2. The test equipment required is listed in Table 4-1. The bench test interconnections are shown in Figure 4-2. Unless otherwise specified, all operating controls referenced in the table are located on the receiver front panel.

Table 4-1. Test Equipment and Accessories

Qty	Name	Designation or Characteristic
1	Antenna Position Simulator	ARC Type SA-40C
1	Shielded Room*	(Refer to paragraph 4-2.)
1	Signal Generator	Hewlett-Packard Model 606A
1	Audio Oscillator	Hewlett-Packard Model 200AB
1	Frequency Counter	Hewlett-Packard Model 5216A
1	Vacuum Tube Voltmeter	Hewlett-Packard Model 410C
1	Vacuum Tube Voltmeter	Ballantine Model 300D
1	R-f Voltmeter	Boonton Electronics Model 91DA
1	Power Supply	0-36 vdc, 3 A minimum (with a built-in ammeter)
1	Oscilloscope	Tektronix Model 310A
1	Stop Watch	Central Scientific Model 73536 (0-10 seconds)
1	Oscilloscope Probe	Tektronix Model 013-071 10X
1	ADF Indicator	ARC IN-12-1
1	Test Pointer	ARC 28775-0005 or -0006
AR	Cable	ARC-11318 (RG-58/U)
1	Adapter	ARC-11368 (UG-273/U)
7	Connector	ARC-11337 (UG-88C/U)
2	Connector	ARC-14129 (UG-274/U)
1	Receiver Cable Assembly	(See Figure 4-2.)
1	Loop Cable Assembly	ARC-33287 or ARC-32803
1	Sense Antenna Cable Assembly	ARC-17984 or ARC-18637
1	Test Extender Card	ARC-41219
1	Test Extender Card	ARC-41366

*Necessary only if SA-40C Antenna Position Simulator is not available.

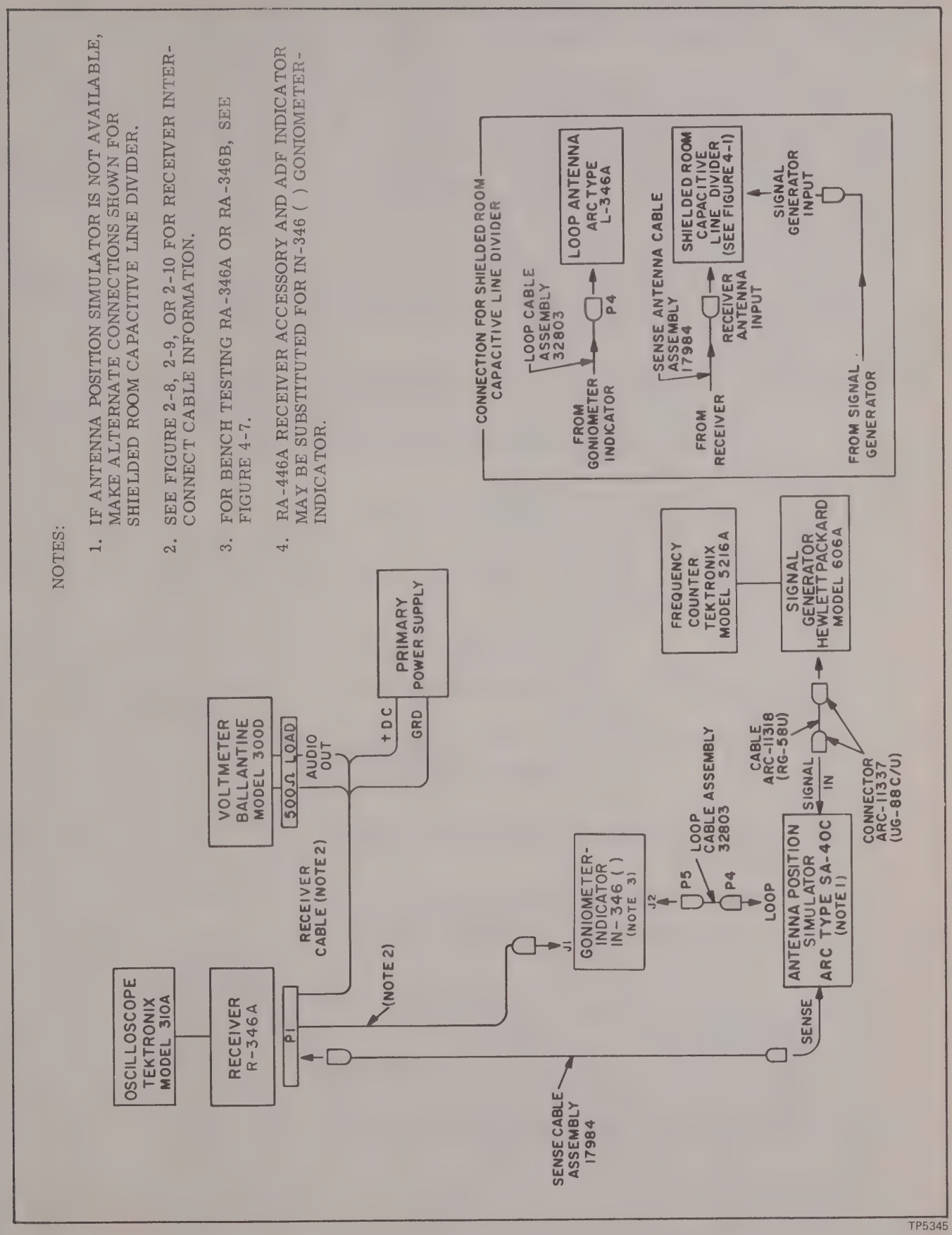


Figure 4-2. Cessna 400 ADF, Bench Test Interconnection Diagram

Any performance check may be made separately but the Preliminary Procedure must have been completed previously.

Signal Source. As shown in Figure 4-2, the output of the signal generator is connected either to the SIG GEN connector on the antenna position simulator or to the input connector of the shielded room capacitive line divider. When the FUNCTION switch of the antenna positon simulator or shielded room is in the ANT position, the signal generator is fed through a 50 pF capacitor to the 100 pF sense antenna cable. In the LOOP COMP position, the signal from the signal generator is coupled to the sense antenna cable to provide 1/4-meter antenna effective height and also to feed one of two wire radiators which supply the loop signal. The BEARING TEST switch of the antenna position simulator determines which wire radiator is used. Since the goniometer-indicator pointer may not indicate the bearing selected by the BEARING TEST switch, the correct pointer positions for the different antenna locations are as follows.

BEARING TEST SWITCH	TOP LOOP		BOTTOM LOOP	
	TOP SENSE	BOTTOM SENSE	TOP SENSE	BOTTOM SENSE
0°	180°	0°	0°	180°
90°	90°	270°	90°	270°

The LOOP COMP position of the antenna position simulator FUNCTION switch also provides direct conversion of signal generator microvolts to microvolts/meter field strength. The LOOP COMP position of the capacitive line divider FUNCTION switch, when used in a calibrated shielded room, also provides conversion to microvolts/meter field strength, but the microvolt output of the signal generator must be divided by the "room factor" to obtain the microvolts/meter field strength at the antenna input to the receiver. In the ANT position, the microvolt outout of the signal generator is used directly.

Audio Output. A 500-ohm noninductive load must be connected across the audio output terminals (AUDIO OUT). Test equipment used to measure the audio output must have a high input impedance to prevent "loading" the audio output circuit.

Signal Generatcr Accuracy. In the following performance checks, a Hewlett-Packard Model 5216A Frequency Counter is used to determine the correct frequency settings of the Hewlett-Packard Model 606A Signal Generator.

Table 4-2. Performance Checks

Step	Procedure	Normal Indication
	PRELIMINARY PROCEDURE	
1	Interconnect Cessna 400 ADF and test equipment as shown in Figure 4-2.	None.
2	Prepare all test equipment for operation.	None.
3	Adjust primary power supply to 13.75 volts.	If connected, receiver panel lamps light.
4	Set antenna position simulator SELECTOR switch to L-521B/L-318G position.	None.
5	Set antenna position simulator or shielded room FUNCTION switch to LOOP-COMP position.	None.
6	Set AUDIO LEVEL SET control A3R15 (accessible through top dust cover) to maximum CW position.	None.

Table 4-2. Performance Checks (Cont)

Step	Procedure	Normal Indication
	RECEIVER MCW SENSITIVITY	
1	Set Hewlett-Packard Model 606A Signal Generator output to 70 uV at 220 kHz with 30 percent modulation at 1,000 Hz.	None.
2	Set receiver to 220 kHz and push in REC push-button.	(Depends on VOL control setting.)
3	Adjust VOL control for 2.5-volt indication on Ballatine Model 300D VTVM.	300D indicates a reading of 2.5 volts.
4	Remove modulation.	300D indicates a minimum of 6 dB below 2.5 volts.
5	Repeat Steps 1 through 4, setting signal generator and receiver to the following frequencies: 380 kHz, 415 kHz, 800 kHz, 950 kHz, and 1,600 kHz.	Same as Steps 2 through 4 for each frequency.
	RECEIVER CW SENSITIVITY	
1	Set Hewlett-Packard Model 606A Signal Generator output to 50 microvolts at 220 kHz with no modulation.	None.
2	Set receiver to 220 kHz and push in BFO pushbutton.	(Depends on VOL control setting.)
3	Adjust VOL control for 2.5-volt reading on Ballantine Model 300D VTVM.	300D indicates a reading of 2.5 volts.
4	Reduce signal generator output to zero.	300D indicates a minimum of 6 dB below 2.5 volts.
5	Repeat steps 1 through 4, setting signal generator and receiver to the following frequencies: 380 kHz, 415 kHz, 800 kHz, 950 kHz, and 1,600 kHz.	Same as steps 2 through 4 for each frequency.
	THRESHOLD SENSITIVITY (ADF)	
1	Set Hewlett-Packard Model 606A Signal Generator output to 100 microvolts at 220 kHz with 30 percent modulation at 1,000 Hz.	None.
2	Set receiver to 220 kHz and push in ADF pushbutton.	(Depends on VOL control setting.)
3	Adjust VOL control for a 2.5-volt indication on Ballantine Model 300D VTVM. Adjust goniometer-indicator VAR control to align 0° with index.	300D indicates a reading of 2.5 volts and goniometer-indicator indicates 0° ±3°.
4	Remove modulation.	300D indicates a minimum of 6 dB below 2.5 volts.

Table 4-2. Performance Checks (Cont)

Step	Procedure	Normal Indication
	THRESHOLD SENSITIVITY (ADF) (Cont)	
5	Repeat steps 1 through 4, setting signal generator and receiver to the following frequencies: 415 kHz and 950 kHz.	
	COMPASS SENSITIVITY	
1	Set Hewlett-Packard Model 606A Signal Generator output to 50 microvolts at 220 kHz with no modulation.	None.
2	Set receiver to 220 kHz and push in ADF pushbutton. Adjust goniometer-indicator VAR control to align 0° with index.	Goniometer-indicator indicates 0° ±3°.
3	Push and then release antenna position simulator BEARING TEST switch.	Goniometer-indicator indicates 90° and then returns to 0°.
4	Push in and hold receiver TEST switch until goniometer-indicator indicates 175°. Release TEST switch and note time required for goniometer-indicator to return to 0° ±3°.	Goniometer-indicator pointer returns in less than 7 seconds.
5	Push in REC pushbutton.	Goniometer-indicator indicates 90° ±3°.
6	Push in ADF pushbutton.	Goniometer-indicator indicates 0° ±3°.
7	Repeat steps 1, 2, and 3, with signal generator r-f output level set at 100,000 microvolts.	Goniometer-indicator indicates 0° ± 3°.
8	Repeat steps 1 through 7, setting signal generator and receiver to the following frequencies: 380 kHz, 415 kHz, 800 kHz, 950 kHz, and 1,600 kHz.	Same as steps 3 through 7 for each frequency.
	FREQUENCY INDICATOR ACCURACY	
1	Connect a Tektronix Probe Model 013-071 10X from A7-TP1 to Hewlett-Packard Model 5216A Frequency Counter.	None.
2	Push in REC pushbutton and adjust VOL control to minimum output position.	None.
3	Set receiver to 220 kHz.	Frequency counter indicates 361* kHz ±36 Hz.
4	Set receiver to 415 kHz.	Frequency counter indicates 556* kHz ±55 Hz.
5	Set receiver to 800 kHz.	Frequency counter indicates 941* kHz ±94 Hz.

*This measures local oscillator frequency and provides an indication of receiver accuracy.

Table 4-2. Performance Checks (Cont)

Step	Procedure	Normal Indication
	FREQUENCY INDICATOR ACCURACY (Cont)	
6	Set receiver to 950 kHz.	Frequency counter indicates 1091* kHz ±109 Hz.
7	Set receiver to 1,600 kHz.	Frequency counter indicates 1741* kHz ±174 Hz.
	AGC, POWER OUTPUT, AND MANUAL GAIN CONTROL	
1	Set Hewlett-Packard Model 606A Signal Generator to 100 microvolts at 370 kHz with 30 percent modulation at 1,000 Hz.	None.
2	Set receiver at 370 kHz and push in REC pushbutton.	(Depends on VOL control setting.)
3	Adjust VOL control for a 2.5-volt reading on Ballantine Model 300D VTVM.	300D indicates 2.5 volts.
4	Set signal generator r-f output level as follows and note indications on 300D: 70, 1,000, 10,000, 100,000, and 500,000 microvolts. (Maintain the 100-Microvolt level as the zero dB reference level.)	Maximum difference in 300D indications over signal input range is 7 dB.
5	Set signal generator r-f output level to 100 microvolts and adjust VOL control fully clockwise. Observe audio output level.	Audio output level is 100 mw (7.07 volts rms on 300D).
6	Set signal generator r-f output level to 500,000 microvolts and adjust VOL control fully counterclockwise. Observe audio output level.	Audio output level is 0.01 volts maximum.
	SELECTIVITY	
1	Set Hewlett-Packard Model 606A Signal Generator output to 25 microvolts at 220 kHz with 30 percent modulation at 400 Hz.	None.
2	Set receiver to 220 kHz and push in REC pushbutton.	(Depends on VOL control setting.)
3	Adjust VOL control for a 2.5-volt indication on Ballantine Model 300D VTVM. (Do not disturb this setting.)	300D indicates 2.5 volts.
4	Set signal generator to 50 microvolts and adjust its frequency output between 210 and 230 kHz for a 2.5-volt indication on the 300D at frequencies below and above 220 kHz.	Difference between low and high frequency output where 2.5 volts is indicated on 300D is 4 kHz maximum.
5	Repeat step 4 with the signal generator level set at 44,250 microvolts.	Difference between low and high frequency output where 2.5 volts is indicated on 300D is 12 kHz maximum.

*This measures local oscillator frequency and provides an indication of receiver accuracy.

4-8. TROUBLE-SHOOTING.

Table 4-3 lists symptoms of some possible troubles which may be encountered during operation of the Cessna 400 ADF set, as well as their probable causes, and the procedures to be used to verify each probable cause. Voltage measurements are shown on Figure 5-1. Some voltage measurements can only be made by waveform analysis. In the case of waveform measurements, the time base for the oscilloscope is included.

Schematic and wiring diagrams are shown in Section V. Table 4-4 provides module interconnection information and, in conjunction with Figure 5-1, provides point to point module connections through the mother board A8 (Figure 5-8A).

Unless otherwise noted, all parts referred to in Table 4-3 are located in the R-346A Receiver.

TABLE 4-3. TROUBLE-SHOOTING CHART

Symptom	Probable Cause	Procedure
Set inoperative; complete silence in all operating modes throughout entire frequency range. No movement of goniometer-indicator pointer.	No primary power supplied to receiver.	Check fuse (3 amp) A4F1.
	Defective interconnecting wires or faulty connector at receiver mount.	Check continuity of interconnecting wires through connector. (See Figures 2-8, 2-9, or 2-10 as applicable.)
	Receiver defective.	Remove receiver for bench test.
No audio output; equipment functions normally otherwise.	Defective audio circuit.	Make voltage reading at A3U2.
	Defective audio output transformer.	Check continuity of audio output transformer.
	Faulty external wiring.	Check continuity of external wiring.
	Defective audio volume control.	Measure resistance of A9R1 between terminals A9-26 and A9-27. Resistance should increase from approximately 0 ohms to 5000 ohms when control is varied between extreme counterclockwise to extreme clockwise positions.
Noisy reception.	Interference from outside source.	Shut off aircraft engines and other equipment except Cessna 400 ADF. Check reception on several stations.
	Poor ground connections.	Check all ground connections.
	Defective sense antenna or sense antenna lead-in cable.	Place receiver in REC mode and check reception of known weak station.
	Defective loop antenna, loop cable assembly, goniometer, or goniometer cable.	Place receiver in ADF mode and check reception of both strong and known weak stations. Observe action of goniometer-indicator when checking.

TABLE 4-3. TROUBLE-SHOOTING CHART (Cont)

Symptom	Probable Cause	Procedure
Goniometer-indicator pointer moves when TEST pushbutton is depressed, but does not move when stations are tuned in. Audio is normal in REC position.	Defective homing circuits, loop cable assembly, or goniometer cable.	Make voltage measurements at A1Q3, A2Q3, and A2Q4. (See Figure 5-1.)
Normal operation from 200 kHz to 399 kHz. Weak or no reception from 400 kHz to 1699 kHz.	Defective band-switching transistors.	Check voltages at A1Q1, A1Q2, A2Q1, A2Q2, A2Q5, A2Q6, A2Q7, A2Q9, A2Q10, A2Q11, A2Q12, A7Q1, A7Q2, A7Q3, and A7Q4. (See Figure 5-1.)
Normal operation from 200 kHz to 799 kHz. Weak or no reception from 800 kHz to 1699 kHz.	Defective band-switching transistors.	Check voltages at A1Q2, A2Q1, A2Q7, A2Q10, A2Q12, A7Q3, or A7Q4. (See Figure 5-1.)
Goniometer-indicator pointer does not move when TEST pushbutton depressed. Normal audio with REC pushbutton depressed.	Defective servo circuits.	Check voltages at A4Q1 through A4Q6. (See Figure 5-1.)
	Defective interconnecting wiring.	Check continuity of interconnecting wiring. (See Figures 2-8, 2-9, and 2-10, as applicable.)
Goniometer-indicator reads 180° from correct station bearing. Note Erroneous directional information may be given during checks on the ground due to reflections from nearby buildings or power lines. Make suitable height checks to be sure trouble actually exists.	Defective loop transformer A1T1, A1T2, or A1T3.	Remove receiver for bench test.
	Incorrect interconnecting wiring at loop antenna, goniometer, or receiver cable.	Check continuity of wiring. (See Figures 2-8, 2-9, or 2-10) and check for correct wiring relative to loop and sense antenna locations.
	Loop antenna mounted incorrectly.	Remove loop cable assembly. Key on loop connector should face forward end of aircraft.
Goniometer-indicator pointer rotates more than 180° when aircraft is turned 90°.	Defective loop or receiver cable assembly.	Check continuity of cables. (See Figures 2-8, 2-9, or 2-10.)
In ADF mode, goniometer-indicator pointer moves left when aircraft is turned left and right when aircraft is turned right.	Incorrect interconnection wiring.	Check continuity of interconnecting wiring. (See Figures 2-8, 2-9, and 2-10) and check for correct wiring relative to loop and sense antenna locations.

TABLE 4-3. TROUBLE-SHOOTING CHART (Cont)

Symptom	Probable Cause	Procedure
Goniometer-indicator pointer rotates very slowly to station bearing during ADF operation or with TEST pushbutton depressed.	Poor gain of servo amplifier stages.	Make voltage measurements at A4Q3 through A4Q6. (See Figure 5-1.)
	Reference frequency oscillator off frequency.	Remove receiver for bench check. Check frequency of 160 Hz oscillator A4Q1 and A4Q2. (See Figure 5-1.)
	Defective sense antenna.	Check sense antenna installation.
Goniometer-indicator pointer rotates rapidly with no signal input (drift greater than 180° in 10 seconds).	Improper setting of balance control A2R12.	Make adjustments according to alignment procedure. (Refer to paragraph 4-9.)
	Defective balanced modulator circuit.	Remove receiver for bench test. Make voltage measurements at A2Q3 and A2Q4. (See Figure 5-1.)
Goniometer-indicator pointer shows station on strong signals only. (Pointer rotates normally with TEST switch depressed.)	Defective r-f stage.	Remove receiver for bench test. Make voltage readings of r-f circuit. (See Figure 5-1.)

SHOP NOTES:

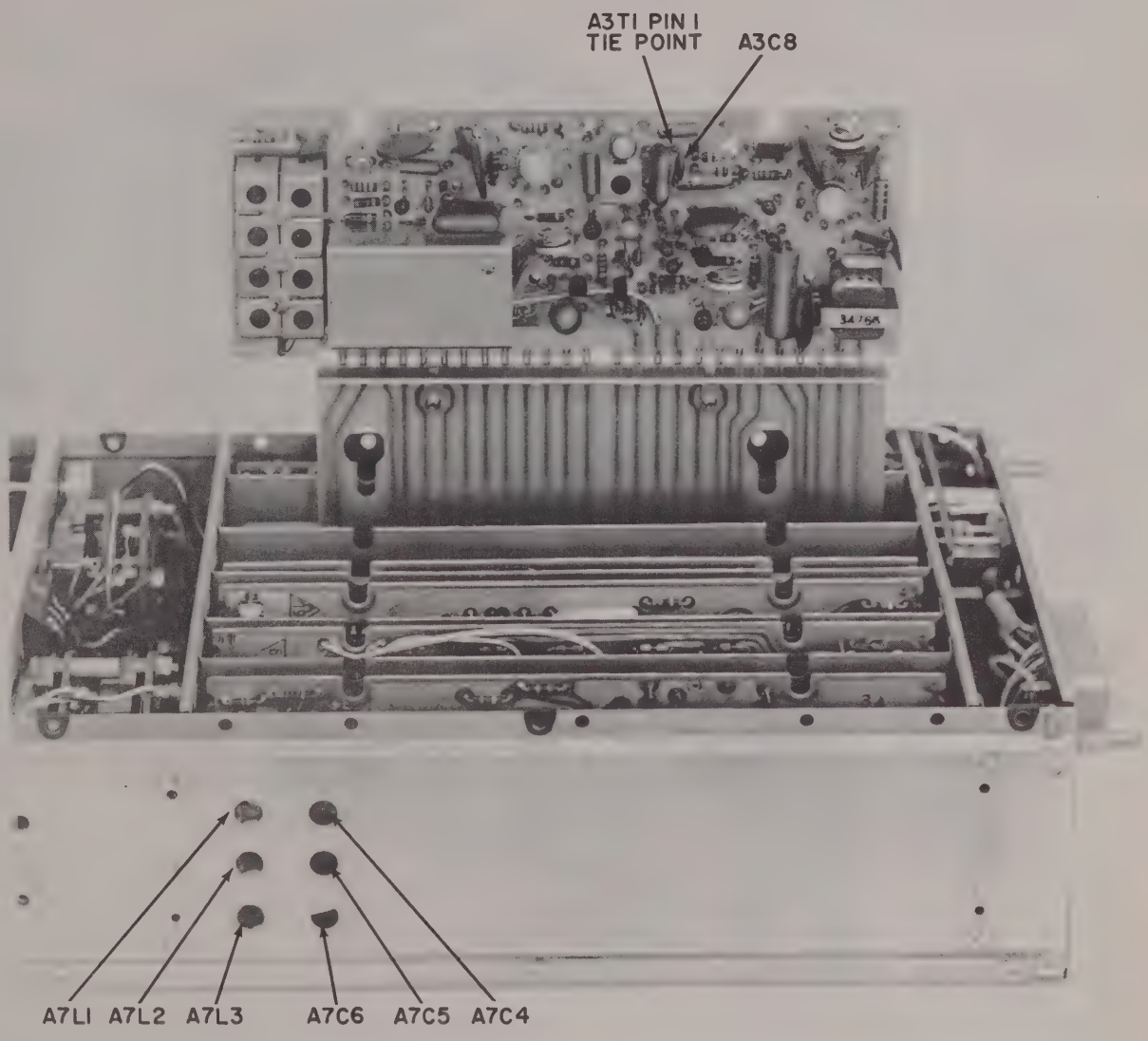


Figure 4-3. R-346A Receiver, Alignment Points (Sheet 1 of 2)

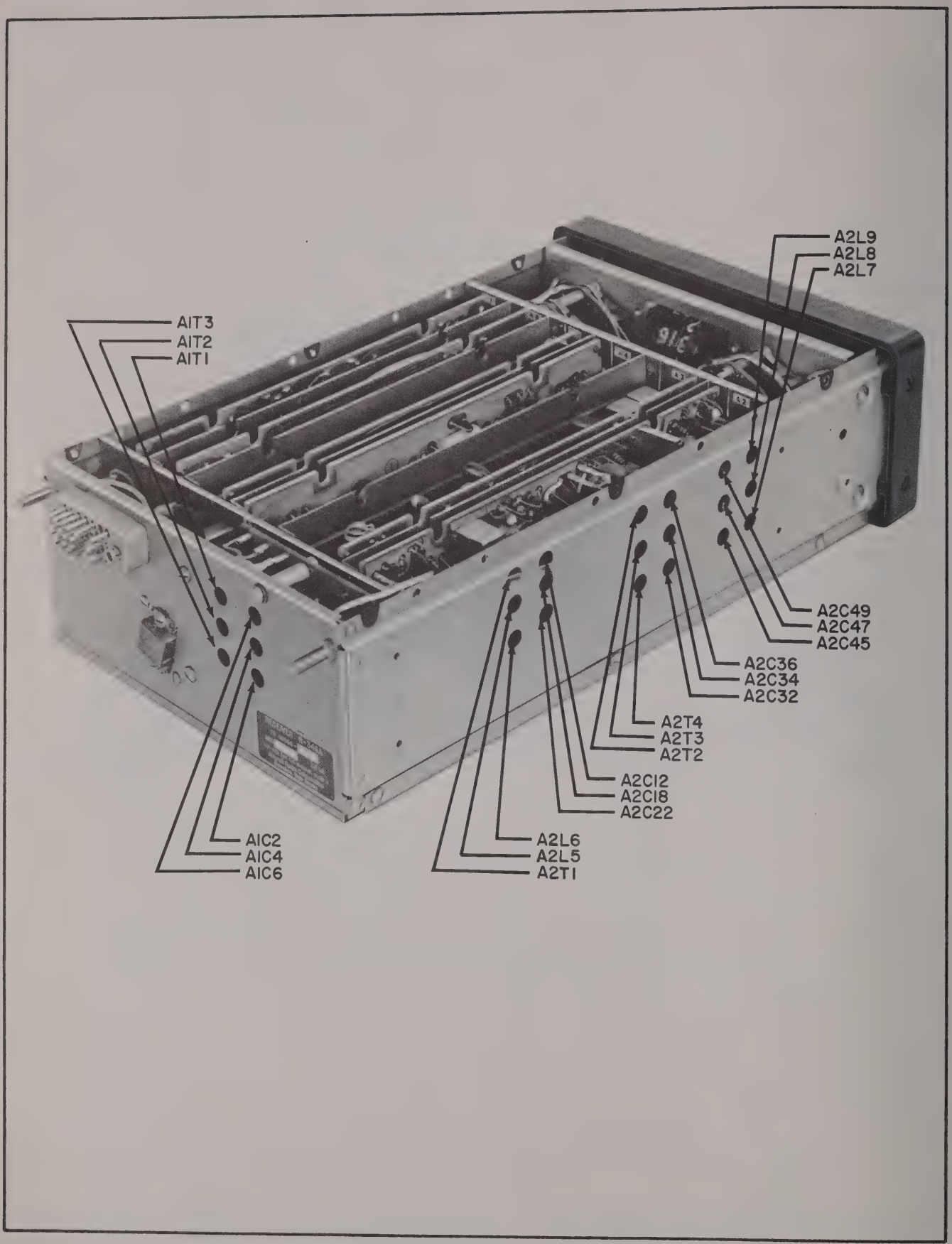


Figure 4-3. R-346A Receiver, Alignment Points (Sheet 2 of 2)

4-9. RECEIVER ALIGNMENT AND ADJUSTMENT.

The following alignment and adjustment procedures for the receiver assemblies are presented in a recommended sequence of performance if all assemblies are to be aligned and adjusted. However, except for the preliminary procedure, an individual assembly may be aligned or adjusted without necessarily performing any of the other procedures. The alignment or adjustment procedure for a specific assembly is identified by a paragraph heading preceding the applicable procedural steps.

The test equipment required for alignment and adjustment is listed in Table 4-1 and is shown in Figure 4-2. The signal source and audio output information contained in paragraph 4-7 is applicable. Alignment and adjustment points are shown in Figure 4-3, Figures 5-2 through 5-6, and Figure 5-8. After completing any alignment or adjustment, the applicable checks of Table 4-2 should be made to verify performance.

Preliminary Procedure.

Step 1. Remove top dust cover from receiver.

Step 2. Interconnect the units of the Cessna 400 ADF and connect the test equipment as shown in Figure 4-2.

Step 3. Prepare all test equipment for operation. Set antenna simulator FUNCTION switch to LOOP-COMP position and SELECTOR switch to L-521B/L-318G position.

Step 4. Adjust primary power supply to 13.75 volts dc.

NOTE

Whenever power is applied to the receiver, check that the current drawn is approximately 1 ampere if the receiver panel lamps are connected, or approximately 0.6 ampere if the panel lamps are not connected.

Power Supply and Servo Amplifier Adjustment.

Step 1. Remove servo assembly A4 from receiver. Connect servo assembly to Test Extender Card ARC-41219. Install test extender card with servo assembly in receiver.

Step 2. Connect Hewlett-Packard Model 410C VTVM to junction of A4R11 and A4R26 (see Figure 5-5.)

Step 3. Push in ADF pushbutton. Adjust A4R27 until 410C reads 9.3 ± 0.1 volts dc.

Step 4. Connect Tektronix Model 013-071 10X Oscilloscope Probe (vertical) from Tektronix Model 310A Oscilloscope to junction of A4R2 and A4C3. Connect Hewlett-Packard Model 200AB Audio Oscillator to horizontal terminals of oscilloscope.

Step 5. Adjust audio oscillator frequency until it is equal to frequency of servo oscillator as indicated on the oscilloscope by a stationary, circular pattern with one loop. This frequency must be between 150 Hz and 170 Hz. (Do not alter this audio oscillator frequency setting even though the oscilloscope pattern may vary due to oscillator drift.)

Step 6. Connect Ballantine Model 300D VTVM probe to A4-16 (alternative connection point is the dot, or positive, lead of A4C13).

Step 7. Push in REC pushbutton.

Step 8. Connect audio oscillator to A4-14. Maintain the audio oscillator frequency of Step 5 and adjust the audio oscillator level to obtain 2 volts as read on the Ballantine Model 300D.

Step 9. Adjust A4R9 for a maximum reading on the 300D. If necessary, readjust audio oscillator level to obtain a 2-volt reading on the 300D.

Step 10. Adjust A4R15 for a maximum reading on the 300D. If necessary, readjust audio oscillator level to obtain a 2-volt reading on the 300D.

Step 11. Repeat Steps 9 and 10 until no further improvement is observed.

Step 12. Disconnect audio oscillator and 300D. Remove test extender card with servo assembly, separate, and reinstall servo assembly in receiver.

Phase Detector Adjustment.

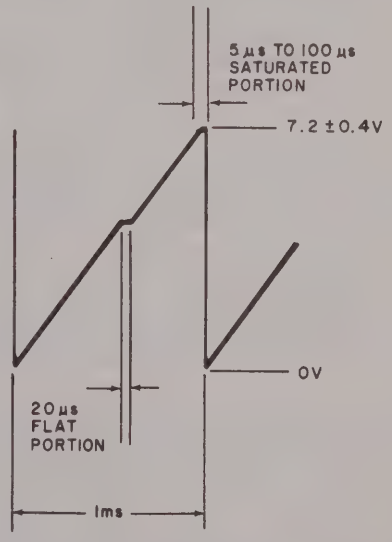
Step 1. Remove phase detector assembly A5 from receiver. Connect phase detector assembly to Test Extender Card ARC-41219. Install test extender card with phase detector assembly in receiver.

Step 2. Set receiver to 200 kHz and push in REC pushbutton.

Step 3. Set Tektronix Model 310A Oscilloscope to 0.1 V/cm, 200 μs/cm, DC vertical coupling, and Trigger to internal negative.

Step 4. Connect Tektronix Model 013-071 10X Oscilloscope Probe from oscilloscope to A5TP1 (see Figure 5-6).

Step 5. Adjust A5R4 for maximum amplitude of the following waveform observed on the oscilloscope, and, if necessary, adjust A5R36 for a stable waveform.



Step 6. Set receiver to 399 kHz. Adjust A5R36 so that the flat portion of the waveform is 1.1 volts below the peak amplitude.

Step 7. Set receiver to 400 kHz. If necessary, adjust A5R47 for a stable waveform.

Step 8. Set receiver to 1,699 kHz. If necessary, adjust A5R47 for a stable waveform.

Step 9. Decrease the receiver frequency in 100-kHz decrements to 299 kHz. If necessary, adjust

A5R36 or A5R47, or both, to obtain a stable waveform at each frequency setting.

Step 10. Increase the receiver frequency in 100 kHz increments to 1,699 kHz. If necessary, adjust A5R36 or A5R47, or both, to obtain a stable waveform at each frequency setting.

Step 11. Set the receiver to 1600 kHz. Decrease the receiver frequency in 100-kHz decrements to 200 kHz, and then increase the receiver frequency in 100 kHz increments to 1600 kHz. If necessary, adjust A5R36 or A5R47, or both, to obtain a stable waveform at each frequency setting.

Step 12. For each receiver frequency setting ending in 00 and 99, turn receiver power off and then on, and observe waveform. If necessary, adjust A5R36 or A5R36 or A5R47, or both, to obtain a stable waveform at each frequency setting.

Step 13. If either A5R36 or A5R47, or both, had to be adjusted in Steps 9, 10, 11, 12 to obtain a stable waveform at any frequency setting, repeat Steps 9, 10, 11, and 12 until no further adjustment is necessary.

Step 14. Disconnect oscilloscope. Remove test extender card with phase detector assembly, separate, and reinstall phase detector assembly in receiver.

I-F Alignment and Adjustment.

Step 1. Remove i-f assembly A3 from receiver. Connect i-f assembly to Test Extender Card ARC-41219. Install test extender card with i-f assembly in receiver.

Step 2. Using Hewlett-Packard Model 5216A Frequency Counter, set Hewlett-Packard Model 606A Signal Generator to 141 kHz.

Step 3. Set signal generator r-f level to zero with 30% modulation at 1000 Hz. Connect signal generator through a series-connected 0.68-microfarad capacitor to junction of A3R1 and A3C1.

Step 4. Connect Hewlett-Packard Model 410C VTVM to A3C30 and chassis ground. Push in REC pushbutton. Adjust A3R28 for 5.4 volts dc. Disconnect 410C.

Step 5. With Ballantine Model 300D VTVM connected across 500-ohm load, adjust signal generator to 50 microvolts, and adjust A3T1 for maximum audio output as indicated on 300D.

Step 6. Connect 410C to junction of A3R14 and A3CR3 and chassis ground.

Step 7. Adjust signal generator to 1000-microvolt output, and adjust A3R36 for 410C reading of 6 volts dc.

Step 8. Disconnect 410C and signal generator. Remove test extender card with i-f assembly, separate, and reinstall i-f assembly in receiver.

VCO Alignment.

Step 1. Connect Hewlett-Packard Model 410C VTVM to A5TP3. Push in REC pushbutton.

Step 2. With no r-f signal applied to receiver, set receiver frequency to 800 kHz and adjust A7L1 for 1.5 volts dc.

Step 3. Set receiver frequency to 1699 kHz and adjust A7C4 for 6.5 volts dc.

Step 4. Repeat Steps 2 and 3 until the two voltages are exactly 1.5 volts dc and 6.5 volts dc, respectively.

Step 5. Set receiver frequency to 400 kHz and adjust A7L2 for 1.5 volts dc.

Step 6. Set receiver frequency to 799 kHz and adjust A7C5 for 6.0 volts dc.

Step 7. Repeat Steps 5 and 6 until the two voltages are exactly 1.5 volts dc and 6.0 volts dc, respectively.

Step 8. Set receiver frequency to 200 kHz and adjust A7L3 for 1.5 volts dc.

Step 9. Set receiver frequency to 399 kHz and adjust A7C6 for 6.0 volts dc.

Step 10. Repeat Steps 8 and 9 until the two voltages are exactly 1.5 volts dc and 6.0 volts dc, respectively.

R-F Alignment and Adjustment.

Step 1. Connect Hewlett-Packard Model 410C VTVM to high-side of A3C30 (lead nearest front of assembly) and chassis ground.

Step 2. Set receiver frequency to 800 kHz and push in REC pushbutton.

Step 3. Using Hewlett-Packard Model 5216A Frequency Counter, set Hewlett-Packard Model 606A Signal Generator to exactly 800 kHz with no modulation. Adjust r-f output of signal generator to produce 4.0 volts dc, as read on 410C. Adjust A2L7, A2T4, and A2L6 for a null reading on the 410C.

NOTE

Throughout this procedure, use the frequency counter to set the frequency of the signal generator, then disconnect the frequency counter.

Step 4. Set signal generator to 1699 kHz, adjust output for 4.0 volts dc, and adjust A2C45, A2C32, and A2C22 for a null reading on the 410C.

Step 5. Repeat Steps 3 and 4 until no further improvement is observed.

Step 6. Set signal generator to 400 kHz, adjust output for 4.0 volts dc, and adjust A2L8, A2T3, and A2L5 for a null reading on the 410C.

Step 7. Set signal generator to 799 kHz, adjust output for 4.0 volts dc, and adjust A2C47, A3C34, and A2C18 for a null reading on the 410C.

Step 8. Repeat Steps 6 and 7 until no further improvement is observed.

Step 9. Set signal generator to 200 kHz, adjust output for 4.0 volts dc, and adjust A2L9, A2T2, and A2T1 for a null reading on the 410C.

Step 10. Set signal generator to 399 kHz, adjust output for 4.0 volts dc, and adjust A2C49, A2C36, and A2C12 for a null reading on the 410C.

Step 11. Repeat Steps 9 and 10 until no further improvement is observed.

Balanced Modulator Adjustment.

Step 1. Disconnect sense antenna from antenna simulator.

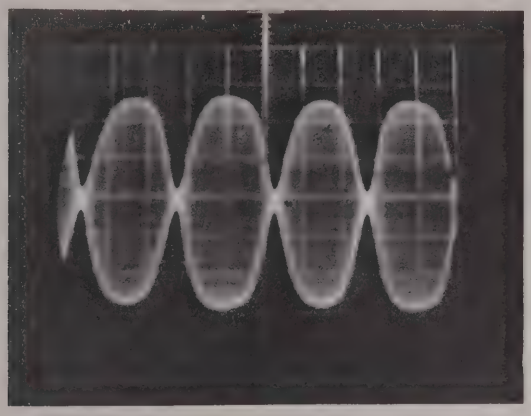
Step 2. Disconnect signal generator from antenna simulator and connect it to A2P21 (A2P21 need not be disconnected).

Step 3. Connect Tektronix Model 013-071 10X Oscilloscope Probe from Tektronix Model 310A Oscilloscope through a series-connected 220,000-ohm resistor to pin 1 of A3T1.

Step 4. Using Hewlett-Packard Model 5216A Frequency Counter, set Hewlett-Packard Model 606A

Signal Generator to 200 kHz. Set receiver frequency to 200-kHz. Push in ADF pushbutton. Set output of signal generator to 5,000 microvolts with no modulation.

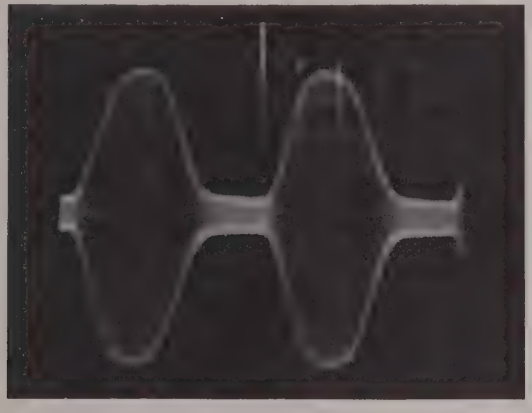
Step 5. Synchronize the oscilloscope to obtain a waveform similar to that shown and adjust A2R12 for equal amplitude of all cycles.



Step 6. Disconnect signal generator from A2P21 and reconnect it to antenna simulator.

Step 7. Remove dust cover from goniometer-indicator. With receiver TEST switch, slew goniometer-indicator pointer to 90-degree position, stop rotation at this point with finger-pressure applied to gear train, and attach a small alligator clip, or similar device, to the gear to maintain pointer in this position.

Step 8. Reconnect sense antenna to antenna simulator. The waveform displayed should now be half the frequency of the waveform displayed previously, as follows:



Loop Alignment and Adjustment.

Step 1. Using Hewlett-Packard Model 5216A Frequency Counter, set Hewlett-Packard Model 606A Signal Generator to 800 kHz. Set receiver frequency to 800 kHz. Push in ADF pushbutton. Set output of signal generator to 5,000 microvolts with no modulation.

Step 2. Connect Tektronix Model 013-071 10X Oscilloscope Probe from Tektronix Model 310A Oscilloscope through a series-connected 220,000-ohm resistor to pin 1 of A3T1. Oscilloscope should display waveform similar to that shown in Step 8 of the procedure for adjusting the balanced modulator.

Step 3. Adjust A1T3 for maximum modulation of the waveform displayed.

Step 4. Set signal generator and receiver to 1699 kHz and adjust A1C2 for maximum modulation.

Step 5. Repeat adjustment of A1T3 at 800 kHz and A1C2 at 1699 kHz until no further improvement is observed.

Step 6. Set signal generator and receiver to 400 kHz and adjust A1T2 for maximum modulation.

Step 7. Set signal generator and receiver to 799kHz and adjust A1C4 for maximum modulation.

Step 8. Repeat Steps 6 and 7 until no further improvement is observed.

Step 9. Set signal generator and receiver to 200 kHz and adjust A1T1 for maximum modulation.

Step 10. Set signal generator and receiver to 399 kHz and adjust A1C6 for maximum modulation.

Step 11. Repeat Steps 9 and 10 until no further improvement is observed.

4-10. GONIOMETER-INDICATOR ALIGNMENT AND ADJUSTMENT.

IN-346A and IN-346B. If the IN-346A or IN-346B has been disassembled, the unit must be aligned and adjusted before reassembly is completed. Reassemble the unit except for the front assembly (items 1 through 17, Figure 6-2A) and proceed as follows:

Step 1. Interconnect goniometer-indicator and test equipment as shown in Figure 4-4.

Step 2. Set Hewlett-Packard Model 606A Signal Generator output for 2 volts at 100 kHz. Adjust Tektronix Model 310A Oscilloscope for suitable presentation.

Step 3. Manually rotate the motor drive gear, accessible at the right of the unit, until the Boonton Electronics Model 91DA RF Voltmeter indicates a null and a horizontal line is displayed on the 310A.

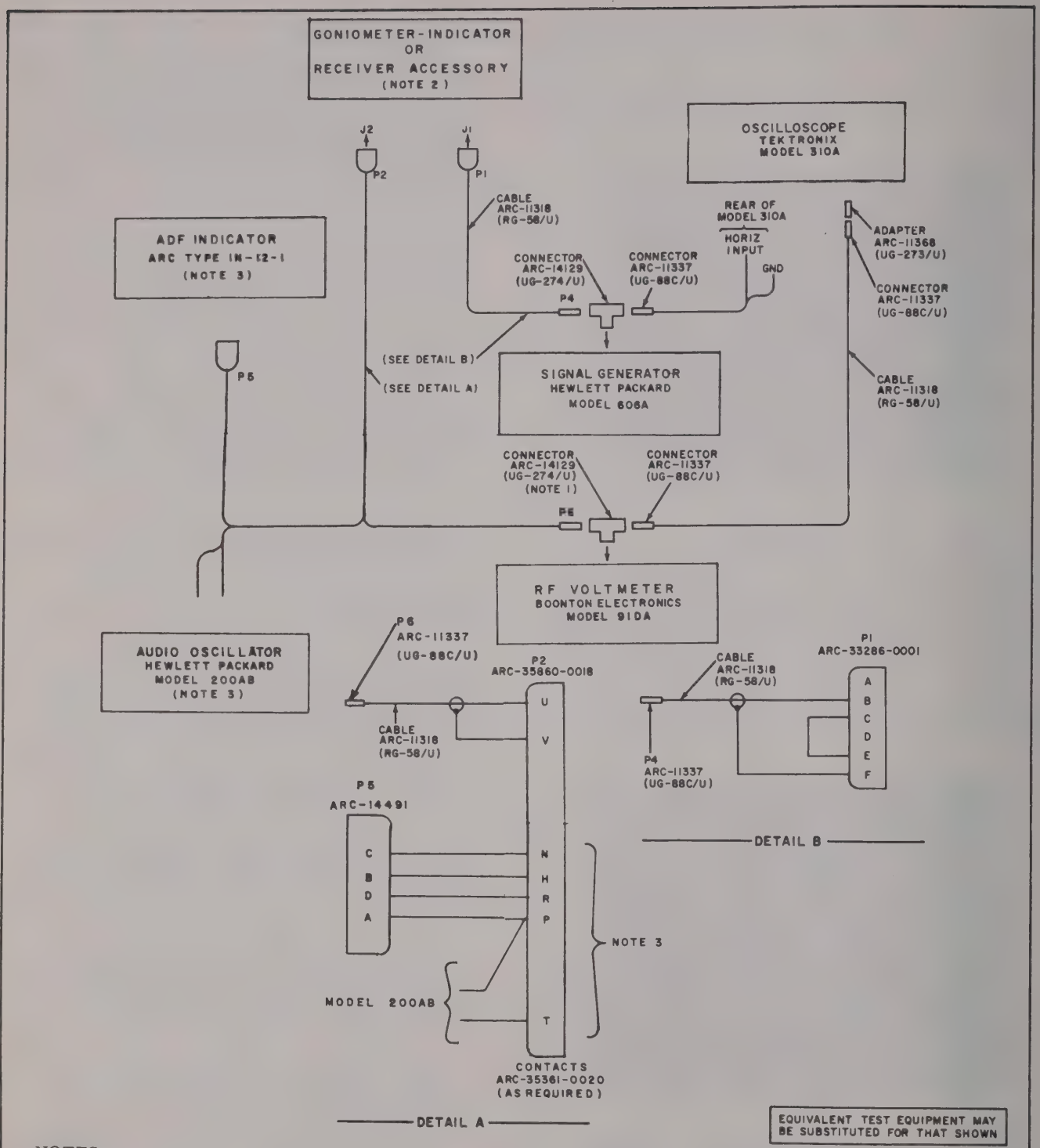
Note

There are two null positions; at the correct null point, pointer and waveform rotate in the same direction.

Step 4. Repeat Step 3 for exact null as indicated by minimum voltage reading on Model 91DA.

Step 5. Rotate knob shaft to set 0 of dial as exactly as possible to the 360-degree position; that is, with 0 at the top of the vertical axis of the dial.

Step 6. Hold motor drive gear firmly in null position of Step 4 to prevent movement of gear train, remove pointer, and replace pointer to indicate 45° as exactly as possible.



NOTES:

1. USE BNC ADAPTER SUPPLIED WITH MODEL 91DA.
2. GONIOMETER-INDICATOR MUST BE WIRED FOR TOP SENSE ANTENNA AND BOTTOM LOOP ANTENNA LOCATIONS.
3. USED ONLY FOR ALIGNMENT OF SYNCHRO TRANSMITTER (IN-346B, IN-346D, OR RA-446A).

TP5349

Figure 4-4. Bench Test Interconnection Diagram for Alignment of Goniometer-Indicators

Step 7. Repeat Steps 3 and 4 to check that null position occurs at exactly 45°, and if necessary, repeat Steps 5 and 6.

Step 8. For IN-346B, set Hewlett-Packard Model 200AB Audio Oscillator for output of 26 volts at 400 Hz. Loosen synchro transmitter screws (74, Figure 6-2A) and rotate synchro until secondary ADF indicator indicates the same as the IN-346B. Tighten the synchro screws.

Step 9. Disconnect and remove goniometer-indicator from test set-up.

Step 10. Continue with reassembly of goniometer-indicator except do not replace outer cover, and adjust pointer-stow switch as follows:

Step 11. Slightly loosen two setscrews (53, Figure 6-2A) in gear assembly (52).

Step 12. Rotate gear assembly so that center of open area on contact plate of gear assembly is under the contacts.

Step 13. Remove button plug (36) from bracket assembly (30). Manually restrict movement of gear, insert screwdriver through hole in bracket assembly into screwdriver slot on back of goniometer shaft, and rotate goniometer shaft to set pointer to 90°.

Step 14. Tighten setscrews (53) and replace button plug (36). Attach cover (2) with screws (3) to complete reassembly of goniometer-indicator.

IN-346C and IN-346D. If the IN-346C or IN-346D has been disassembled, the unit must be aligned and adjusted before reassembly is completed. Reassemble the unit except for the cover, and do not secure the hinged, rear plate on which the connectors are mounted. Then, proceed as follows:

Step 1. Refer to Figure 4-5 or 4-5A. Set all compensation adjustment screws to their maximum counterclockwise positions. Using VAR control, set 0° on dial under index. Using goniometer drive gear, set cam follower over 45° compensation adjustment screw. Note pointer indication.

Step 2. Set 45° compensation adjustment screw to its maximum clockwise position.

CAUTION

To prevent damage to the cam follower track, it may be necessary to adjust adjacent compensation adjustment screws so that the cam follower track is sloped and not bent abruptly.

Note pointer indication. Compute total range of compensation by obtaining difference between pointer reading of this step and Step 1. Divide difference (at least 50°) by 2 and add resultant figure to the lower of the two pointer indications. This figure is the midrange point of the 45° compensation adjustment screw.

Step 3. Set 45° compensation adjustment screw to its mid-range point, as indicated by pointer.

Step 4. If necessary, position cam follower over 45° compensation adjustment screw; then, align fiducial mark and 45° position on goniometer dial by loosending screws securing fiducial bracket in position, adjusting fiducial bracket, and then tightening screws.

Step 5. Interconnect goniometer-indicator and test equipment as shown in Figure 4-4.

Step 6. Set Hewlett-Packard Model 606A Signal Generator output for 2 volts at 100 kHz. Adjust Tektronix Model 310A Oscilloscope for suitable presentation.

Step 7. Manually rotate goniometer drive gear until Boonton Electronics Model 91DA RF Voltmeter indicates a null and a horizontal line is observed on 310A.

Note

There are two null positions; at the correct null point, pointer and waveform rotate in the same direction.

Step 8. Manually restrict movement of gear train, loosen goniometer attaching screws, and adjust goniometer for exact null (as indicated by minimum voltage reading) on Model 91DA. Retighten goniometer attaching screws.

Step 9. Loosen setscrews securing center spring gear and align 45° mark on goniometer dial with fiducial mark. Tighten setscrews.

Step 10. Loosen setscrews securing pointer adjustment gear and align pointer with 45° index. Tighten setscrews.

Step 11. If necessary, repeat Steps 7 through 10 until maximum accuracy of alignment is obtained.

Step 12. Rotate goniometer drive gear until 75° mark on goniometer dial is aligned with fiducial. Adjust 75° compensation adjustment screw until pointer indicates 75°. For each remaining compensation point, adjust the related compensation screw for an equivalent pointer indication.

Step 13. For IN-346D, set Hewlett-Packard Model 200AB Audio Oscillator for output of 26 volts at 400 Hz.

Step 14. Restrict movement of pointer adjustment gear, loosen setscrews in synchro transmitter drive gear, and rotate synchro spring gear until the indication of the IN-12-1 ADF Indicator, or other secondary ADF indicator, is the same as the indication of the IN-346D. Tighten setscrews in drive gear.

Step 15. Check that rotation of indicator pointers of the IN-346D and other ADF indicator is the same.

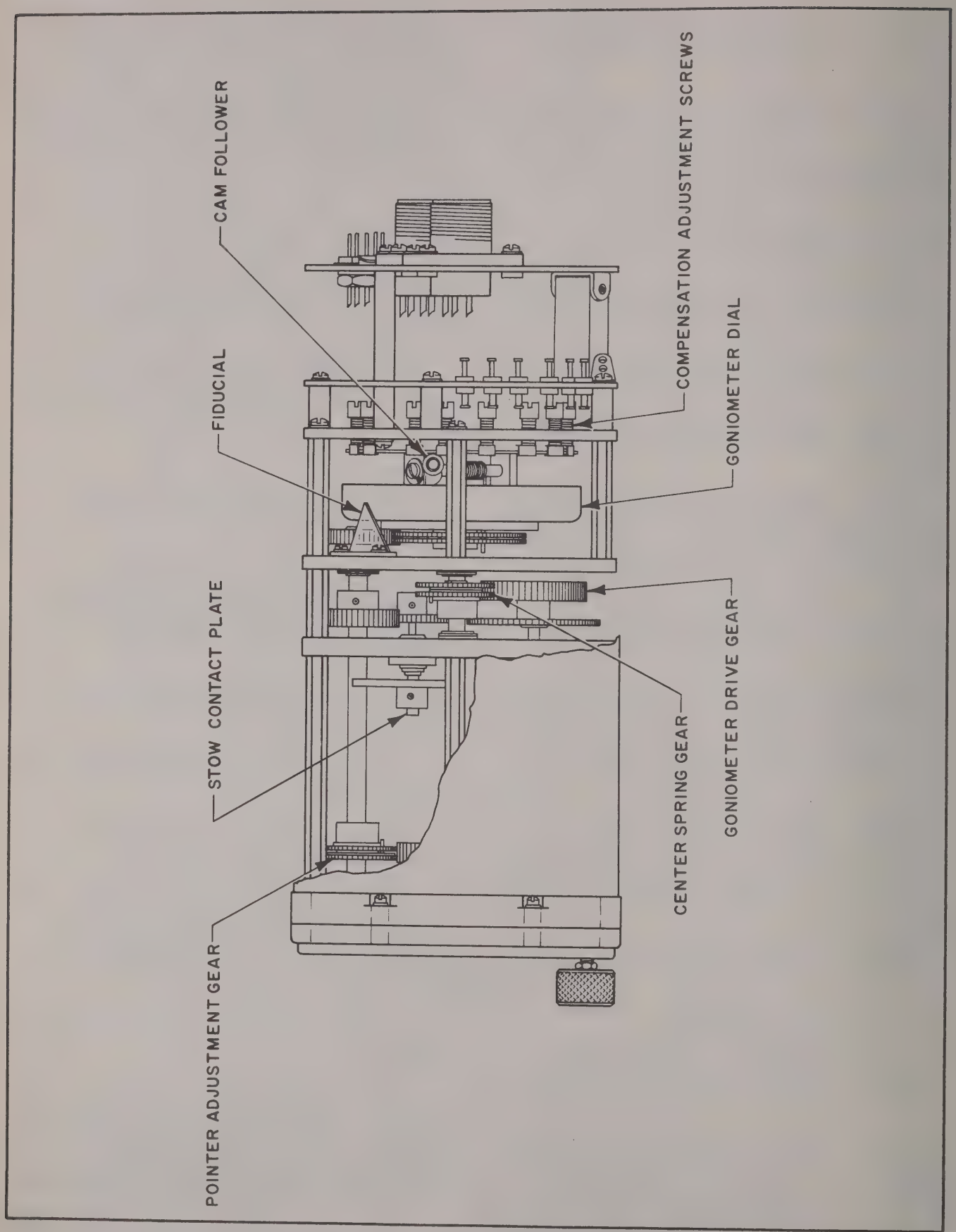


Figure 4-5. IN-346C Goniometer-Indicator, Alignment Points

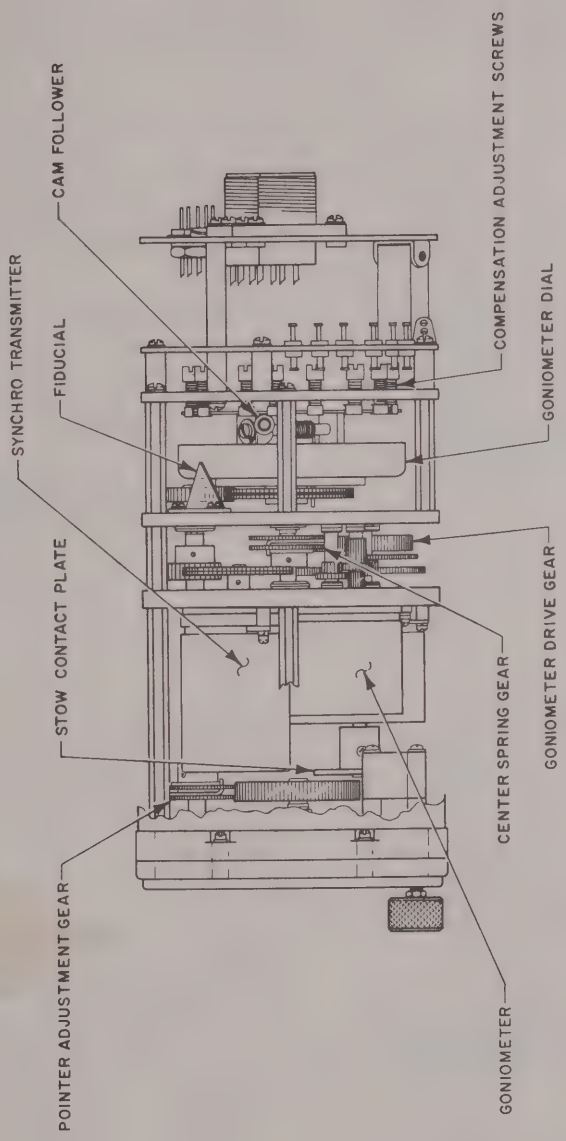


Figure 4-5A. IN-346C and IN-346D Goniometer-Indicators, Alignment Points

Step 16. Disconnect and remove goniometer-indicator from test set-up, and adjust pointer-stow switch as follows:

Step 17. Rotate the VAR knob to align dial 0 with index.

Step 18. Rotate the goniometer gear until the pointer indicates 90°.

Step 19. Loosen two setscrews (74, Figure 6-3 or 67, Figure 6-3A) in contact plate (73, Figure 6-3 or 66, Figure 6-3A) and rotate contact plate until center of open area on contact plate is under the contacts. Tighten setscrews.

Step 20. Complete reassembly of goniometer-indicator.

4-11. RECEIVER ACCESSORY ALIGNMENT AND ADJUSTMENT.

RA-346A and RA-346B. If the RA-346A or RA-346B Receiver Accessory has been disassembled, the unit must be aligned and adjusted before reassembly is completed. A test cable (Figure 4-6) must be fabricated for interconnecting the equipment as shown in Figure 4-7. Alignment points for the receiver accessory are shown in Figure 4-8. Reassemble the unit except for the cover (1, Figure 6-4) and proceed as follows:

Step 1. Interconnect equipment as shown in Figure 4-7.

Note

For RA-346B, depending on the assembly to be aligned, make connections for either ADF 1 or ADF 2 operation. If both assemblies are to be aligned, perform procedure for each assembly.

Step 2. Set Hewlett-Packard Model 606A Signal Generator output for 2 volts at 100 kHz, unmodulated. Set Hewlett-Packard Model 200AB Audio Oscillator output for 26 volts at 400 Hz.

Step 3. Set all compensation adjustment screws to their midpositions. Using VAR control, set 0° on dial under index on ADF indicator. Using goniometer adjustment gear, set cam follower over 45° adjustment screw.

Step 4. Set 45° compensation adjustment screw to maximum counterclockwise position and note pointer reading. Compute total range (55° minimum) of compensation by obtaining the difference between counterclockwise and clockwise pointer readings. Divide difference by 2 and add resultant figure to clockwise pointer reading. This figure is midrange of 45° compensation adjustment screw.

CAUTION

To prevent damage to the cam follower track, it may be necessary to adjust the adjacent compensation adjustment screws so that the cam follower track is sloped and not bent abruptly.

Step 5. Set 45° compensation adjustment screw to its mid-range position.

Step 6. Rotate goniometer adjustment gear until horizontal line is observed on Tektronix Model 310A Oscilloscope. This position is a null position, of which there are two. To determine correct null position, rotate goniometer adjustment gear and observe horizontal line; it should rotate in same direction as pointer of ADF indicator.

Step 7. Observe Boonton Electronics Model 91DA RF Voltmeter and readjust for null.

Step 8. Restrict movement of gear train and loosen setscrews of goniometer dial. Position dial so that 45° mark is aligned with fiducial. Tighten setscrews.

Step 9. While holding goniometer dial in 45° position, loosen setscrews in hub of gear attached to goniometer. Disengage and position cam follower opposite the 45° adjustment screw. Engage gear and tighten hub setscrew.

Step 10. While holding goniometer dial in 45° position, loosen setscrews in hub of gear attached to synchro transmitter shaft.

Step 11. Rotate shaft of synchro transmitter until pointer of ADF indicator is positioned at 45°. Tighten setscrews.

Step 12. Rotate goniometer to each compensation point and adjust compensation screw until pointer of ADF indicator reads the same as the goniometer dial. Do not force adjustment screws; if correct adjustment cannot be obtained, continue with next adjustment screw, and then return. Do not readjust 45° compensation screw. Verify that pointer of ADF indicator nulls at 0°.

Step 13. After completion of alignment, adjust pointer-stow switch by loosening two setscrews (13 or 15, Figure 6-4) and rotate contact plate assembly (12 or 14) so that the center of the open area is over the contact when the indicator pointer is at the 90° mark and the 0° position bearing indicator is at the index mark. Tighten setscrews.

Step 14. Complete reassembly of receiver accessory.

RA-446A. If the RA-446A has been disassembled, the unit must be aligned and adjusted before reassembly is completed. Reassemble the unit except for the mounting plate (4, Figure 6-4A) and the cover (2), and proceed as follows:

Step 1. Interconnect RA-446A and test equipment as shown in Figure 4-4.

Step 2. Set Hewlett-Packard Model 606A Signal

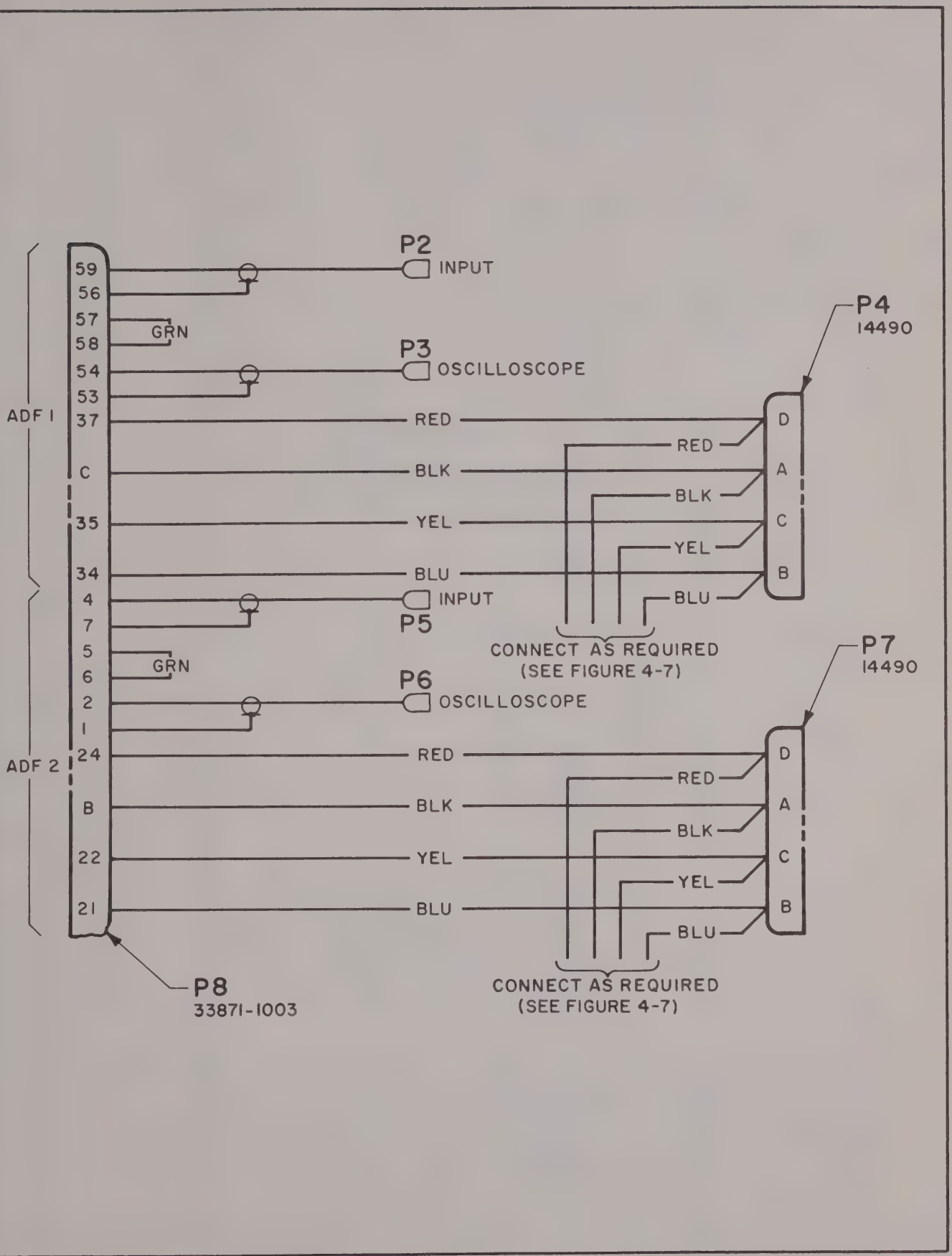


Figure 4-6. Cable Assembly for Bench Testing RA-346A or RA-346B Receiver Accessory, Wiring Diagram

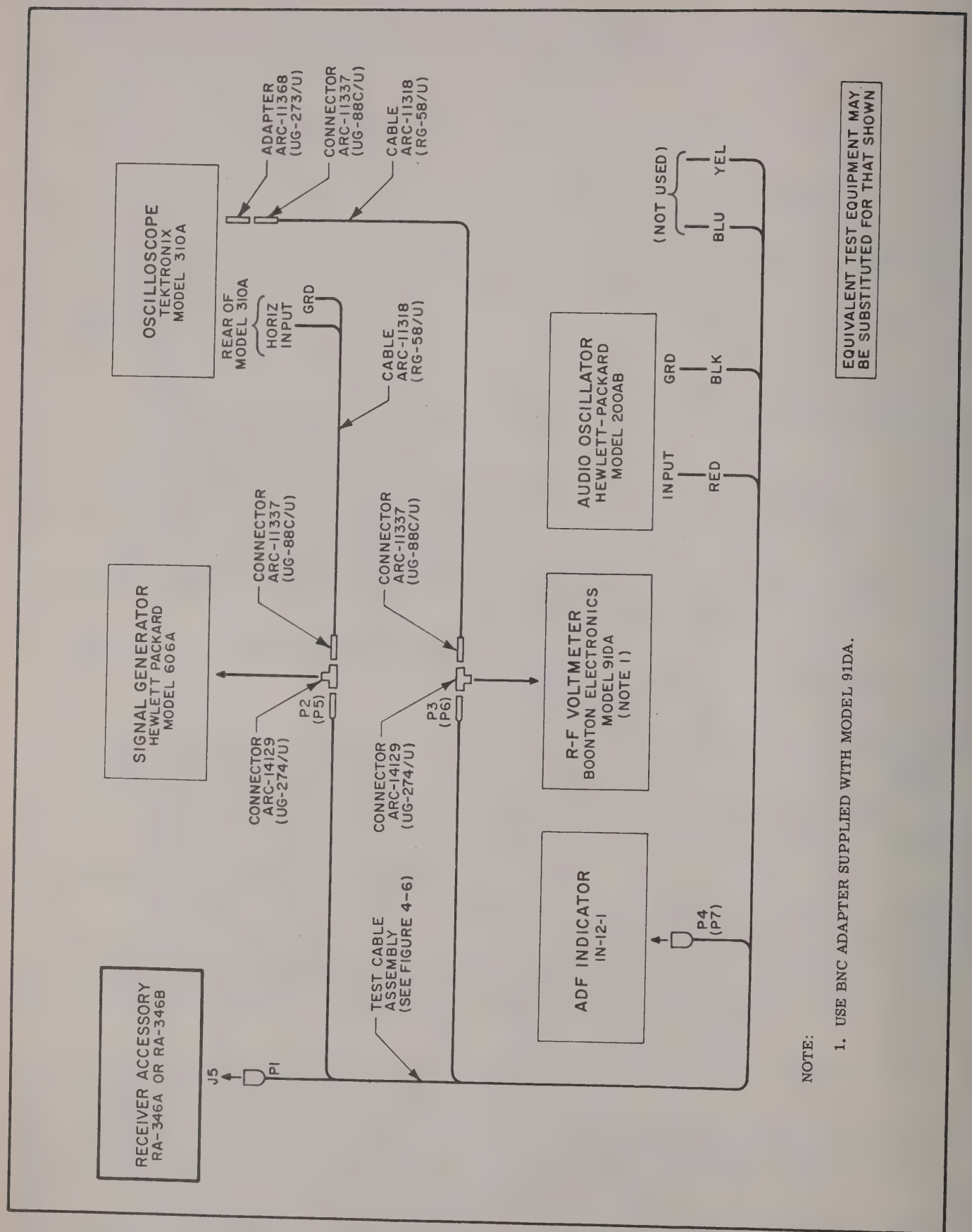


Figure 4-7. RA-346A or RA-346B Receiver Accessory, Bench Test Interconnection Diagram

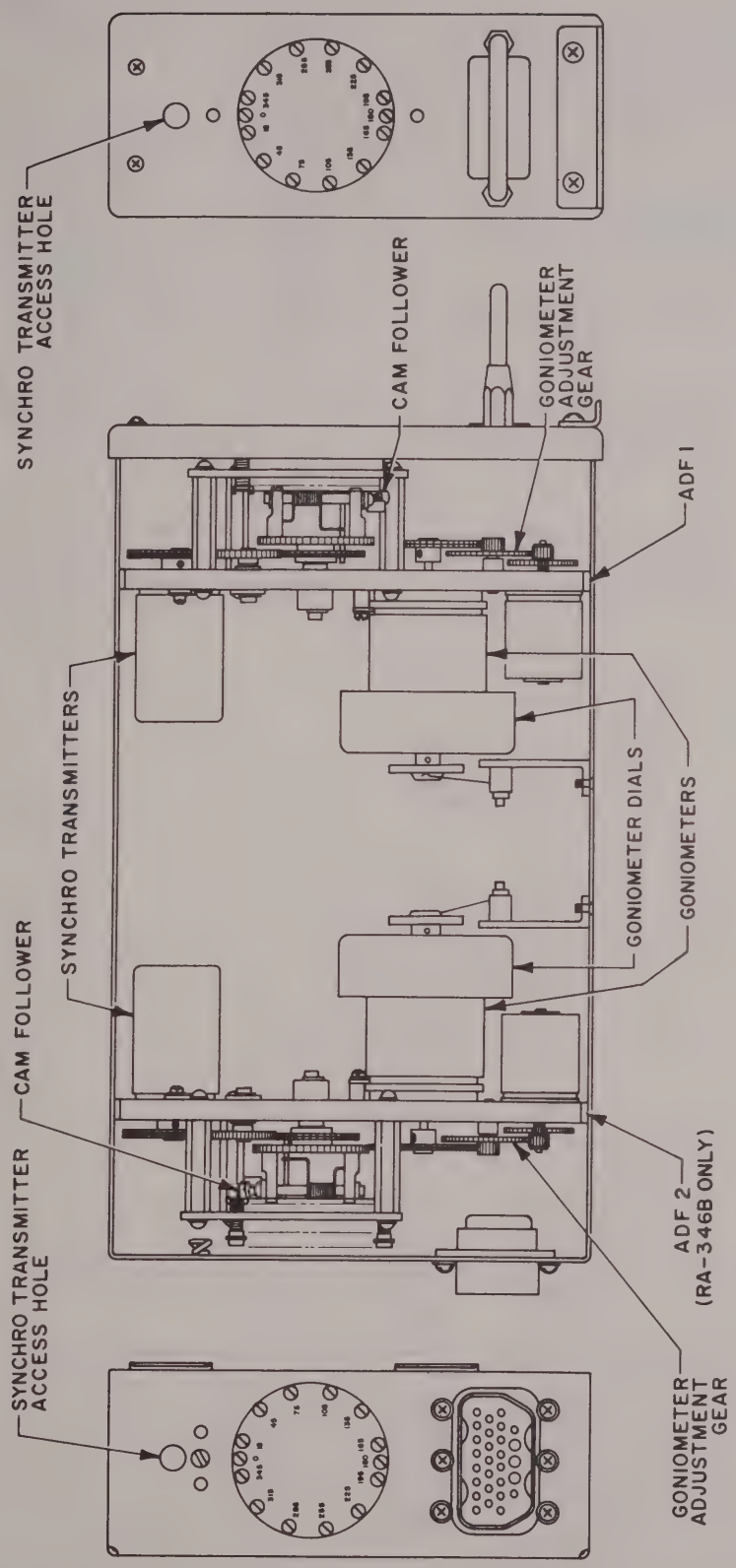


Figure 4-8. RA-346A or RA-346B Receiver Accessory, Alignment Points

Generator output for 2 volts at 100 kHz. Adjust Tektronix Model 310A Oscilloscope for suitable presentation.

Step 3. Manually rotate the motor drive gear until the Boonton Electronics Model 91DA RF Voltmeter indicates a null (minimum voltage) and a horizontal line is displayed on the 310A.

Note

There are two null positions; at the correct null point, goniometer shaft and waveform rotate in the same direction.

Step 4. Repeat Step 3 for exact null as indicated by minimum voltage reading on Model 91DA.

Step 5. Manually restrict movement of gears and attach test pointer to goniometer shaft, aligning the pointer with the 45-degree fiducial marked on the front of the plate.

Step 6. To adjust the pointer-stow position, rotate goniometer gear so that center of open area on contact plate of gear is under the contacts of the molded contact assembly. Place a 1/16-inch thick shim behind the goniometer gear. Manually restrict movement of gears and loosen two setscrews in goniometer gear; rotate goniometer shaft only (gear must not turn) to align test pointer with 90-degree fiducial marked on front of plate; tighten setscrews. Remove shim.

Step 7. Realign test pointer with 45-degree fiducial (null setting).

Step 8. To align synchro transmitter, set Hewlett-Packard Model 200A Audio Oscillator for output of 26 volts at 400 Hz. Loosen synchro transmitter screws (48, Figure 6-A) and rotate synchro until associated ADF indicator indicates 45°; then, tighten synchro screws.

Step 9. Remove test pointer and complete reassembly of receiver accessory.

4-12. MEASUREMENTS.

Typical voltage measurements for the receiver are shown in Figure 5-1. Table 4-4 lists the interconnections through the "mother" board A8 (Figure 5-8A) between the module assemblies.

SHOP NOTES:

TABLE 4-4. MODULE INTERCONNECTIONS

From	To	Function
A1 LOOP AMPLIFIER		
A1-1	A6-23	Band 3 Tune
A1-2	A9-29	+9.3V (ADF operation)
A1-3	--	Spare
A1-4	--	Spare
A1-5	--	Spare
A1-6	A6-24	Band 2 Tune
A1-7	--	Spare
A1-8	--	Spare
A1-9	A5-16	Tuning Voltage
A1-10	--	Ground
P1	J8-DD	Goniometer Shield
P2	J8-CC	Goniometer 1
P3	J8-AA	Goniometer 2
P4	A2-P1	To RF Amp
P5	A2-P2	Ground
A2 RF AMPLIFIER		
A2-1	--	Ground
A2-2	--	Not Used
A2-3	A6-19	Band 3 Tune
A2-4	A9-29	+9.3V ADF
A2-5	A6-22	Band 2 Tune
A2-6	A4-18	160 Hz Input
A2-7	A4-19	160 Hz Input
A2-8	A6-25	Band 2 Tune
A2-9	--	+9.3V
A2-10	A6-23	Band 3 Tune
A2-11	A5-16	Tuning Voltage

TABLE 4-4. MODULE INTERCONNECTIONS (Cont)

From	To	Function
A2 RF AMPLIFIER (Cont)		
A2-12	A6-22	Band 3 Tune
A2-13	--	Not Used
A2-14	--	Not Used
A2-15	A3-12	R-F AGC
A2-16	--	Not Used
A2-17	A6-24	Band 2 Tune
A2-18	A6-23	Band 3 Tune
A2-19	--	Not Used
A2-20	--	Not Used
A2-21	--	Not Used
A2-22	J8-L	+9.3V
A2-23	--	Not Used
A2-24	A7-12	Local Oscillator In
A2-25	A5-16	Tuning Voltage
A2-26	A3-26	I-F Out
P1	A1-P4	R-F Input From Loop Amp
P2	A1-P5	Ground
P3	J8-BB	Sense Ant In
P4	J8-Z	Ground
A3 IF AMPLIFIER, AUDIO AMPLIFIER, BFO, AND AGC		
A3-1	J8-N	Audio Out High
A3-2	J8-R	Audio Out Ground
A3-4	A9-26	VOL Ground
A3-5	A9-27	VOL Arm
A3-6	A9-28	VOL High
A3-7	--	Not Used
A3-8	--	Not Used

TABLE 4-4. MODULE INTERCONNECTIONS (Cont)

From	To	Function
A3 IF AMPLIFIER, AUDIO AMPLIFIER, BFO, AND AGC (Cont)		
A3-9	--	Not Used
A3-10	A4-13	Servo Signal
A3-11	A4-10	+9.3V
A3-12	A2-15	R-F AGC
A3-13 thru A3-23	--	Not Used
A3-24	--	Ground
A3-25	A9-23	+9.3V (BFO)
A3-26	A2-26	I-F Input
A4 SERVO OSCILLATOR, AMPLIFIER, AND POWER SUPPLY		
A4-1 thru A4-7	--	Not Used
A4-8	J8-E A9-20	+14V
A4-9	--	Not Used
A4-10	A5-23 A6-14 A7-9 A3-11 A9-19 J8-L A8Q1 (E)	+9.3V
A4-11	A8Q1 (B)	Regulated Base Voltage
A4-12	A8Q1 (C)	Regulated Collector Voltage
A4-13	A3-10	From Servo Pre-Amp
A4-14	A9-18	Test In
A4-15	--	Ground
A4-16	J8-K	Servo Motor
A4-17	J8-A	Servo Motor Ground
A4-18	A2-6	160 Hz to Balanced Modulator
A4-19	A2-7	160 Hz to Balanced Modulator
A4-20	J8-C	Servo Motor (Fixed Phase 1)

TABLE 4-4. MODULE INTERCONNECTIONS (Cont)

From	To	Function
A4 SERVO OSCILLATOR, AMPLIFIER, AND POWER SUPPLY (Cont)		
A4-21	J8-D	Servo Motor (Fixed Phase 2)
A4-22	A9-17	Test Out
A4-23 thru A4-26	--	Not Used
A5 PHASE DETECTOR		
A5-1 thru A5-13	--	Not Used
A5-14	A7-8	VCO Control
A5-15	A6-13	F/N In
A5-16	A1-9 A2-11 A2-19	Tuning Voltage
A5-17	--	Ground
A5-18	A6-2	S1000
A5-19	A6-6	S400
A5-20	A6-5	S200
A5-21	A6-3	S100
A5-22	A6-21 A7-6	+5V
A5-23	A4-10	+9.3V
A5-24	--	Spare
A5-25	--	Not Used
A5-26	--	Not Used
A6 N DIVIDER		
A6-1	--	Ground
A6-2	A5-18 A9-1	S1000
A6-3	A5-21 A9-3	S100

TABLE 4-4. MODULE INTERCONNECTIONS (Cont)

From	To	Function
A6 N DIVIDER (Cont)		
A6-4	A9-4	S800
A6-5	A5-20 A9-5	S200
A6-6	A5-19 A9-6	S400
A6-7	A9-7	S10
A6-8	A9-16	S80
A6-9	A9-15	S20
A6-10	A9-14	S40
A6-11	--	Spare
A6-12	A7-7	Limited Local Oscillator
A6-13	A5-15	F/N
A6-14	A4-10	+9.3V DC
A6-15	A9-13	S1
A6-16	A9-12	S8
A6-17	A9-11	S2
A6-18	A9-10	S4
A6-19	A9-9 A2-3	Band 3 Control
A6-20	A9-8	Band 2 Control In
A6-21	A7-6 A5-22	+5V
A6-22	A2-5 A2-12	Band 2 Control Out
A6-23	A7-10 A1-1 A2-10 A2-16 A2-18 A2-21	Band 3 Control Out
A6-24	A7-11 A1-6 A2-13 A2-17 A2-20	Band 2 Control Out
A6-25	A2-8	Band 2 Control Out

TABLE 4-4. MODULE INTERCONNECTIONS (Cont)

From	To	Function
A6 N DIVIDER (Cont)		
A6-26	--	Ground
A7 VCO		
A7-1 thru A7-5	--	Not Used
A7-6	A5-22	+5V
A7-7	A6-12	Limited Local Oscillator
A7-8	A5-14	VCO Control In
A7-9	A4-10	+9.3V
A7-10	A6-23	Band 3 Control In
A7-11	A6-24	Band 2 Control In
A7-12	A2-22	Local Oscillator Out
A7-13	--	Ground
A7-14 thru A7-26	--	Not Used
A9 CONTROL		
A9-1	A6-2 A5-18	S1000 Control
A9-2	--	Ground
A9-3	A6-3 A5-21	S100 Control
A9-4	A6-4	S800 Control
A9-5	A6-5 A5-20	S200 Control
A9-6	A6-6 A5-19	S400 Control
A9-7	A6-7	S10 Control
A9-8	A6-17	Band 2 Control
A9-9	A6-19	Band 3 Control
A9-10	A6-18	S4 Control

TABLE 4-4. MODULE INTERCONNECTIONS (Cont)

From	To	Function
A9 CONTROL (Cont)		
A9-11	A6-17	S2 Control
A9-12	A6-16	S8 Control
A9-13	A6-15	S1 Control
A9-14	A6-10	S40 Control
A9-15	A6-9	S20 Control
A9-16	A6-8	S80 Control
A9-17	A4-22	Test Out
A9-18	A4-14	Test In
A9-19	J8-L A2-22 A4-10	 +9.3V (ADF Mode) A8Q1 Emitter
A9-20	J8-C A4-20	 +14V to Goniometer Motor
A9-21	J8-H	+14V In
A9-22	J8-M	Servo Motor Fixed Phase CT (+14V)
A9-23	A3-25	+9.3V BFO Enable
A9-24	J8-P J8-T	 Dimmer +14V
A9-25	J8-F J8-S	 Dimmer +28V
A9-26	--	Ground
A9-27	A3-5	VOL Low (W4)
A9-28	A3-6	VOL High (W4)
A9-29	A1-2 A2-4	 +9.3V (ADV Operation)
A9-30	--	Ground
A9-31	--	Ground

TABLE 4-4. MODULE INTERCONNECTIONS (Cont)

From	To	Function
J8 EXTERNAL CABLE CONNECTOR		
J8-A	--	Ground
J8-B	--	Ground
J8-C	A4-20 A9-20	+14V
J8-D	A4-21	Servo Motor (Fixed Phase 2)
J8-E	A4-8	Stow
J8-F	A9-25 J8-S	14V Light Dimmer
J8-H	A9-21	14V Primary Power In
J8-J	--	Ground
J8-K	A4-16	Servo Motor (Control Phase 1)
J8-L	A9-19	+9.3V Servo Motor (Control Phase 2)
J8-M	A9-22	Servo Motor (Fixed Phase CT)
J8-N	A3-1	Audio High Out
J8-P	A9-24 J8-T	Dimmer (+14V)
J8-R	A3-2	Audio Ground Out
J8-S	J8-F A9-25	Dimmer (+28V)
J8-T	J8-P A9-24	Dimmer (+14V)
J8-U	--	Ground
J8-V	--	Not Used
J8-W	--	Ground
J8-X	--	Not Used
J8-Y	--	Ground
J8-Z	A2-P4	Sense Antenna Shield
J8-BB	A2-P3	Sense Antenna
J8-AA	A1-P3	Goniometer 2 (Loop Antenna In)
J8-CC	A1-P2	Goniometer 1 (Loop Antenna In)
J8-DD	A1-P1	Goniometer Shield

SECTION V

DIAGRAMS

Figure 5-1. R-346A Receiver, Schematic Diagram (Sheet 1 of 4)

Figure 5-1. R-346A Receiver, Schematic Diagram (Sheet 2 of 4)

Figure 5-1. R-346A Receiver, Schematic Diagram (Sheet 3 of 4)

Figure 5-1. R-346A Receiver, Schematic Diagram (Sheet 4 of 4)

Figure 5-2. R-346A Receiver, A1, Loop Amplifier, Part Locations

Figure 5-3. R-346A Receiver, A2, R-F Amplifier, Part Locations (Sheet 1 of 3)

Figure 5-3. R-346A Receiver, A2, R-F Amplifier, Part Locations (Sheet 2 of 3)

Figure 5-3. R-346A Receiver, A2, R-F Amplifier, Part Locations (Sheet 3 of 3)

Figure 5-4. R-346A Receiver, A3, I-F Amplifier, Part Locations

Figure 5-5. R-346A Receiver, A4, Servo Amplifier and Power Supply, Part Locations

Figure 5-6. R-346A Receiver, A5, Phase Detector, Part Locations

Figure 5-7. R-346A Receiver, A6, N Divider, Part Locations

Figure 5-8. R-346A Receiver, A7, VCO (Voltage-Controlled Oscillator), Part Locations

Figure 5-8A. R-346A Receiver, Mother Board Assembly A8, Schematic Diagram

Figure 5-8B. Integrated Circuits (A6, N Divider), Schematic Diagram

Figure 5-8C. IN-346A or IN-346B Goniometer-Indicator, Schematic Diagram

Figure 5-9. IN-346C or IN-346D Goniometer-Indicator, Schematic Diagram

Figure 5-10. RA-346A or RA-346B Receiver Accessory, Schematic Diagram

Figure 5-11. RA-346A or RA-346B Receiver Accessory, Wiring Diagram

Figure 5-11A. RA-446A Receiver Accessory, Schematic Diagram

Figure 5-12. L-346A Loop Antenna, Schematic Diagram

Figure 5-13. M-59B Mounting, Wiring Diagram

Figure 5-14. Loop Cable Assembly, Part No. 33827 or 32803, Wiring Diagram

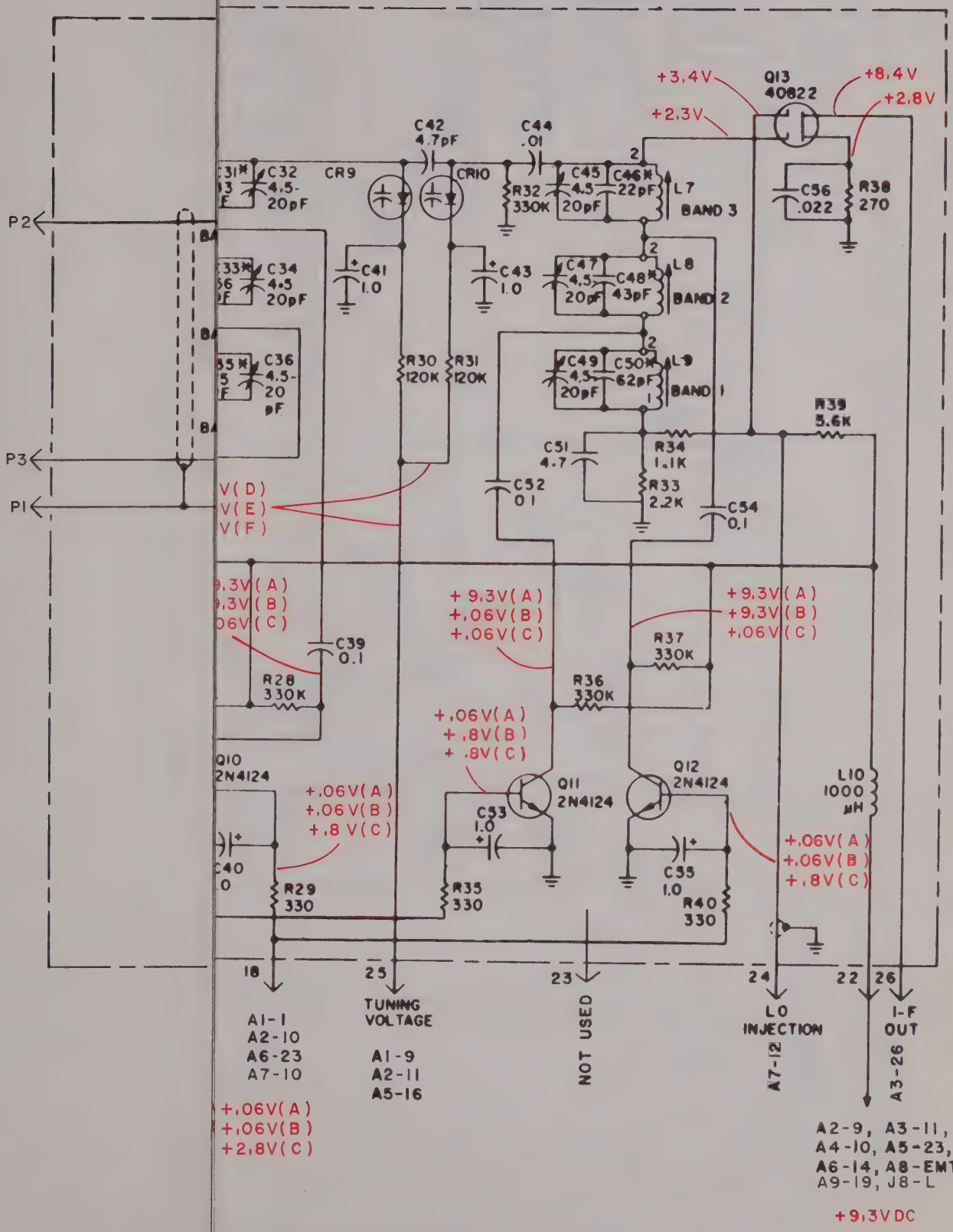


Figure 5-1. R-346A Receiver, Schematic Diagram (Sheet 1 of 4)

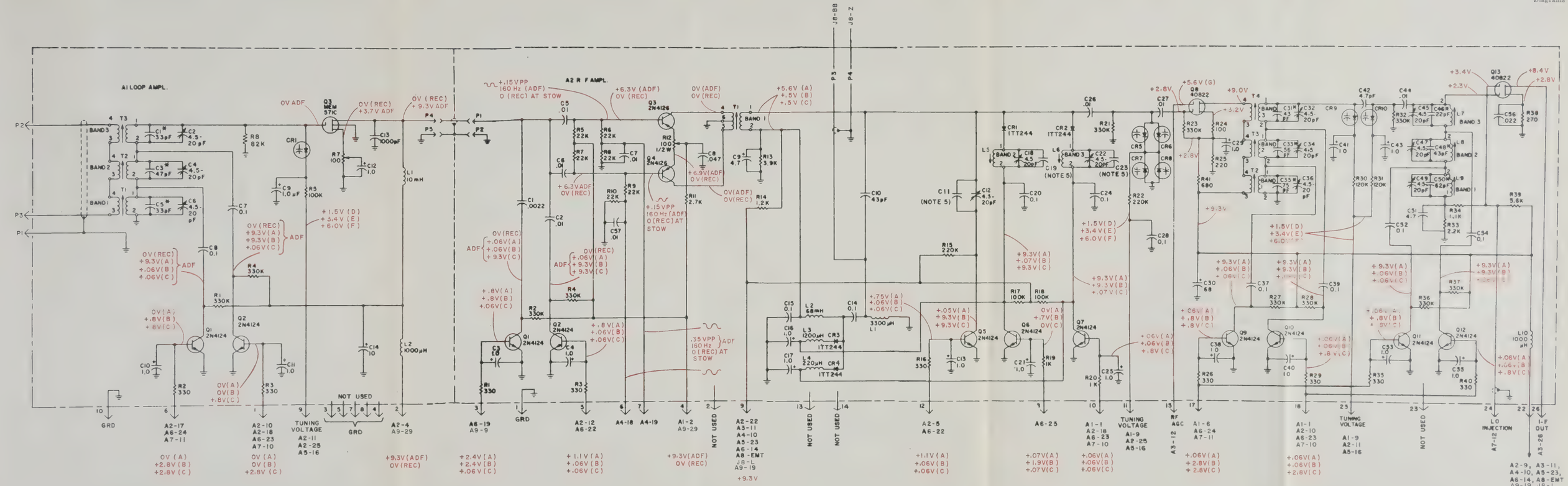
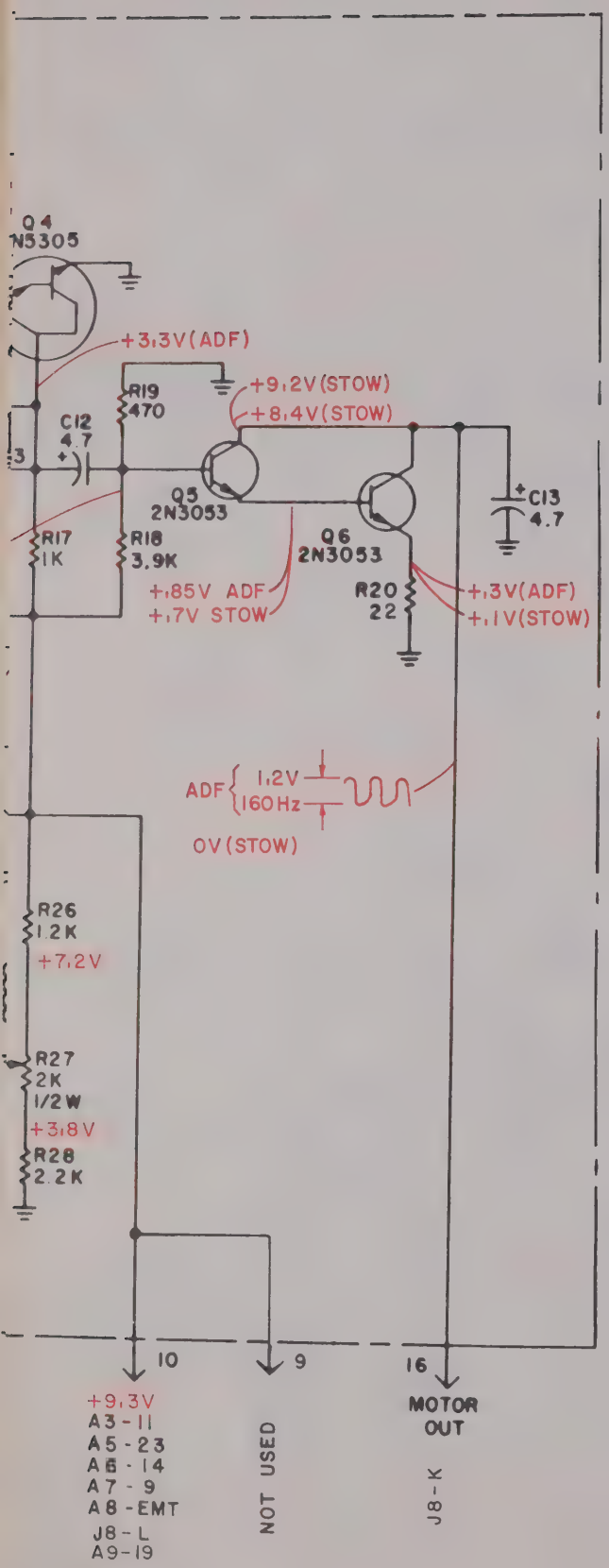
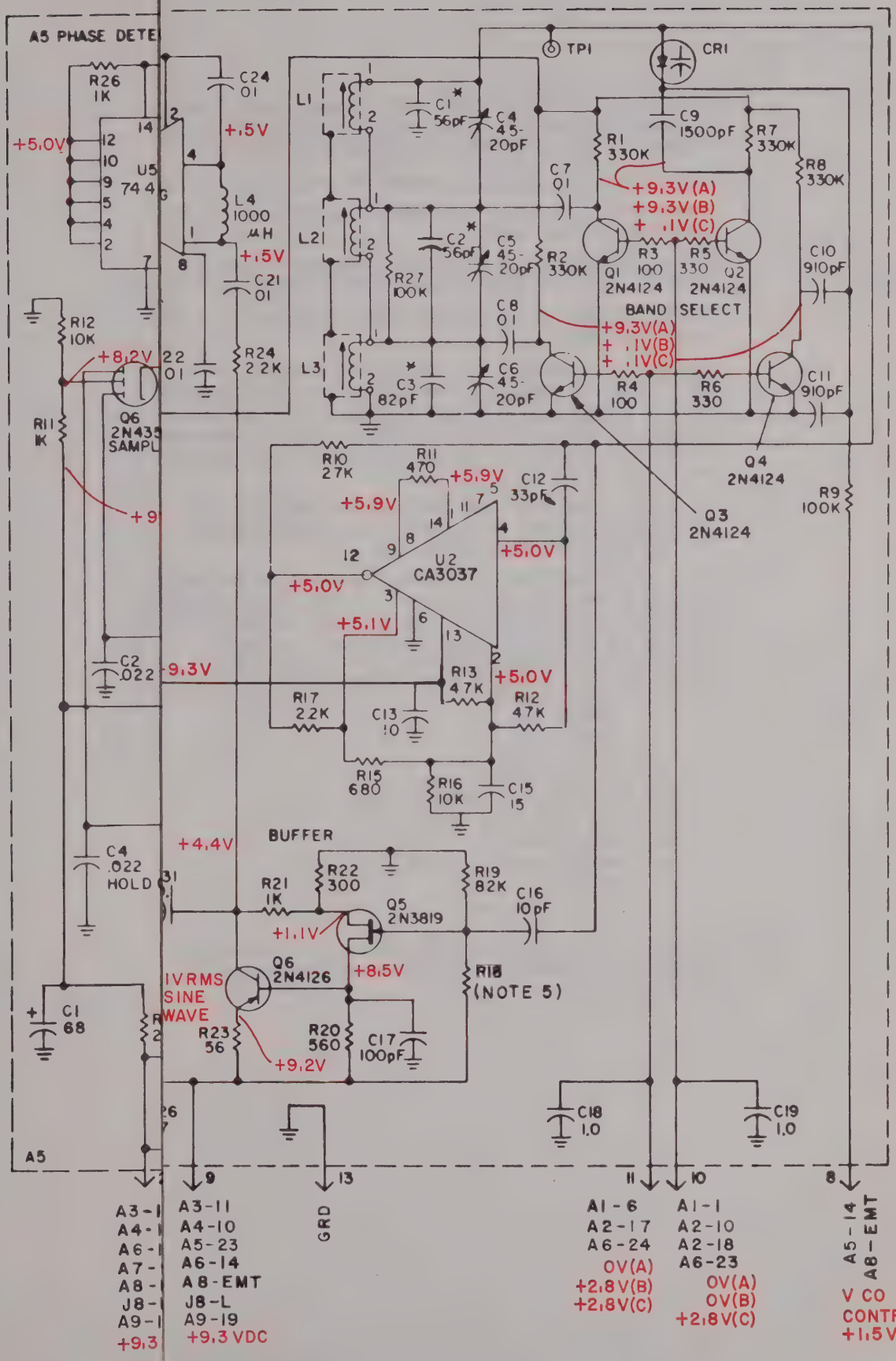


Figure 5-1. R-346A Receiver, Schematic Diagram (Sheet 1 of 4)


Q4
N5305
+3.3V(ADF)
R19
470
C12
4.7
+9.2V(STOW)
+8.4V(STOW)
Q5
2N3053
Q6
2N3053
C13
4.7
R17
1K
R18
3.9K
+.85V ADF
+.7V STOW
R20
22
+.3V(ADF)
+.1V(STOW)
ADF
1.2V
160Hz
0V(STOW)
R26
1.2K
+7.2V
R27
2K
1/2W
+3.8V
R28
2.2K
10
9
16
+9.3V
A3-11
A5-23
A6-14
A7-9
A8-EMT
J8-L
A9-19
NOT USED
MOTOR
OUT
J8-K



re 5-1. R-346A Receiver, Schematic Diagram (Sheet 3 of 4)

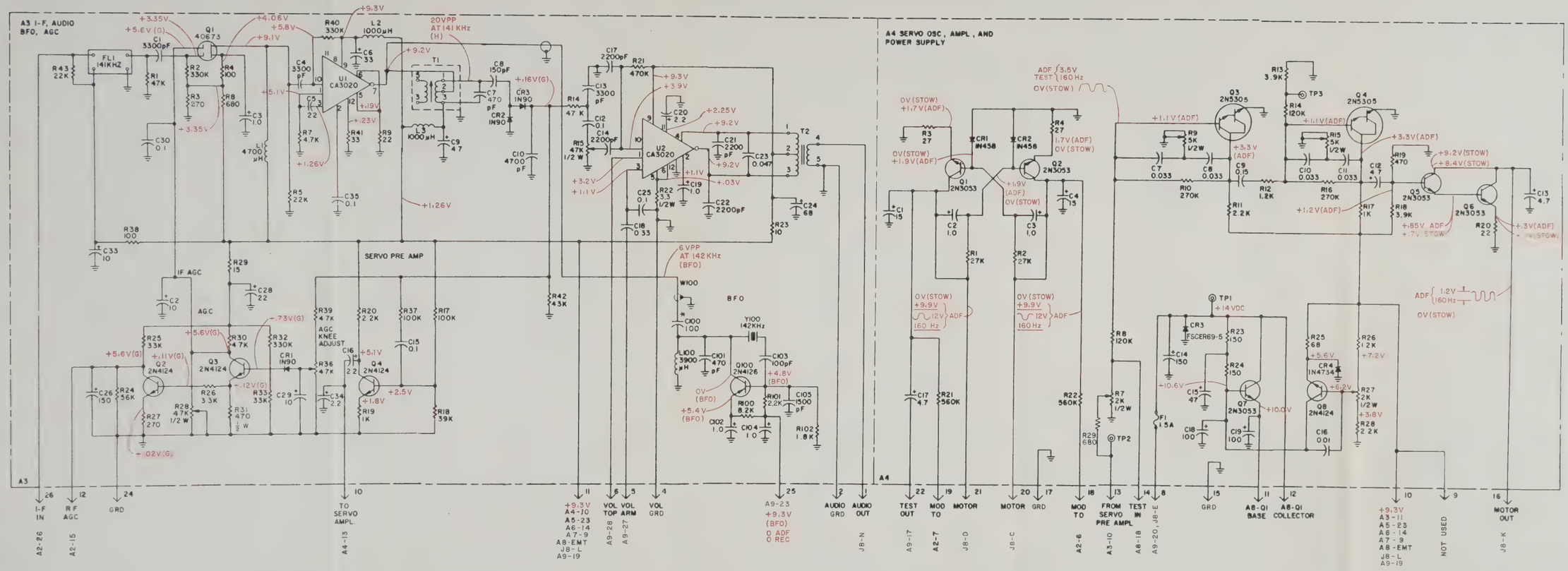


Figure 5-1. R-346A Receiver, Schematic Diagram (Sheet 2 of 4)

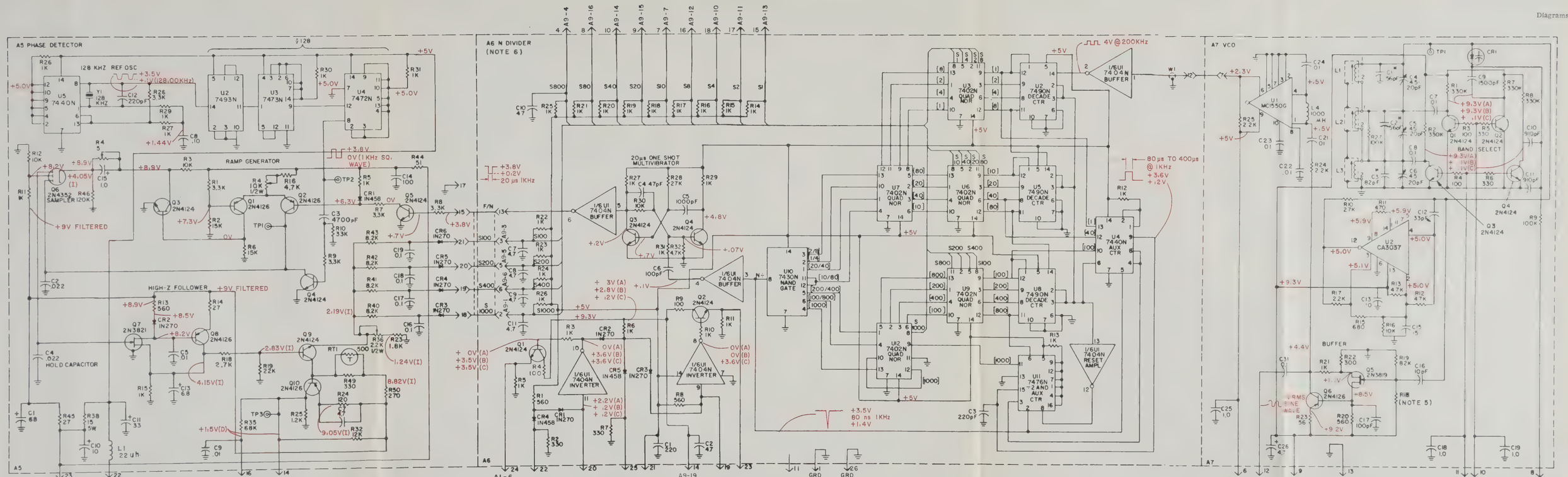
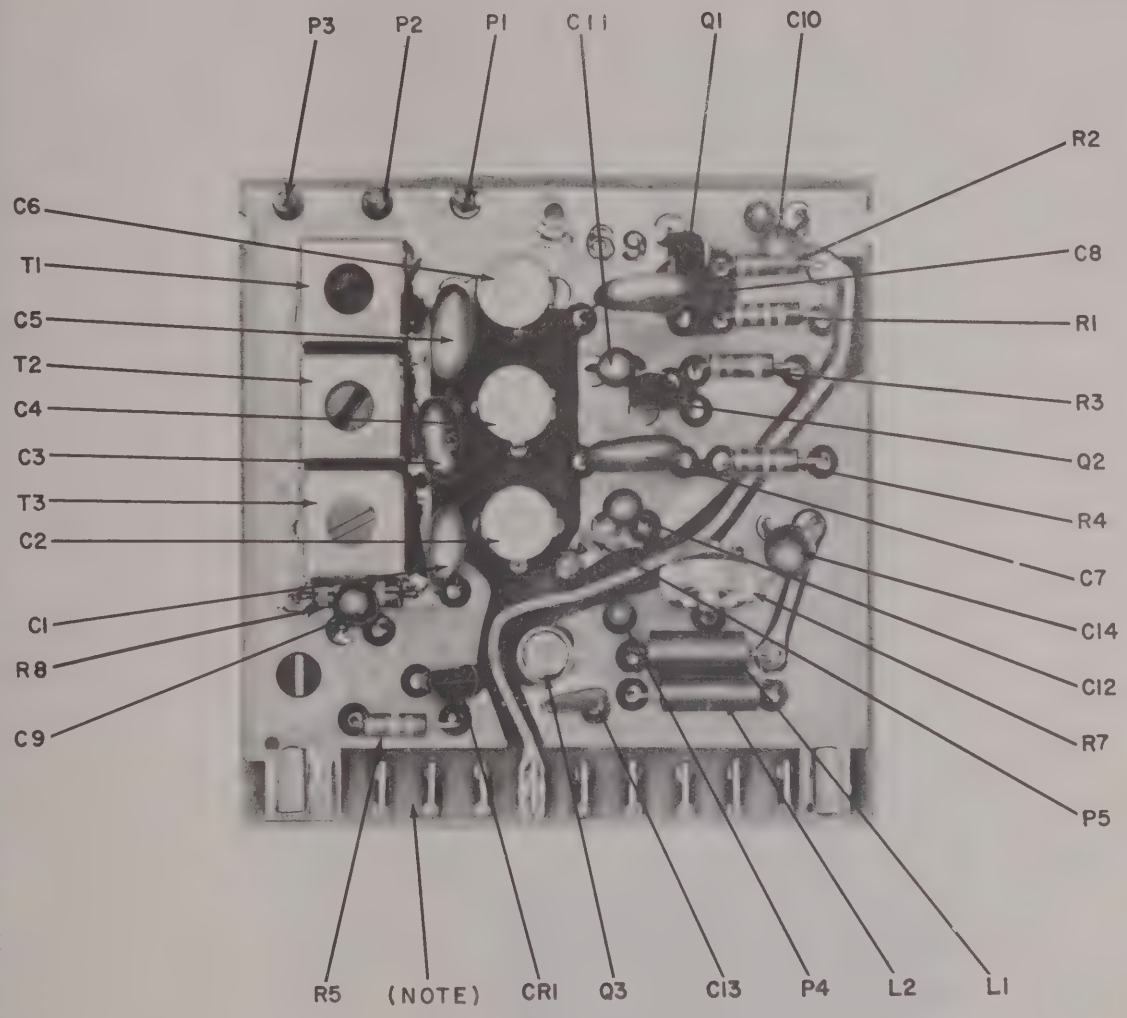


Figure 5-1. R-346A Receiver, Schematic Diagram (Sheet 3 of 4)



NOTE: FROM LEFT TO RIGHT, CONTACTS ARE RELATED TO NUMBERS 10 THROUGH 1 PRINTED ON UNDERSIDE OF MOTHER BOARD AND SHOWN ON FIGURE 5-1.

Figure 5-2. R-346A Receiver, A1, Loop Amplifier, Part Locations

NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX REFERENCE DESIGNATION WITH ASSEMBLY DESIGNATION, FOR EXAMPLE: A2C1.
2. FOR PART LOCATION DIAGRAMS, SEE FIGURES 5-2 THRU 5-8.
3. CAPACITOR VALUES ARE IN MICROFARADS (μF) UNLESS OTHERWISE INDICATED.
4. CAPACITORS MARKED WITH AN ASTERISK (FOR EXAMPLE, A1C1*) ARE SELECTED; VALUE SHOWN IS NOMINAL.
5. VALUE OF A2C11, A2C19, A2C23 SELECTED DURING FINAL FACTORY TESTING.
6. NUMBERS ENCLOSED WITH BRACKETS (FOR EXAMPLE, [80]) INDICATE BINARY CODED DECIMAL (BCD) STATES OF THE COUNTER. NUMBERS PRECEDED BY AN S (FOR EXAMPLE, S200) INDICATE SWITCHING (LOGIC) LINES USED TO SELECT BCD STATE TO DETERMINE RECEIVER OPERATING FREQUENCY.
7. TERMINAL DESIGNATIONS, BOTH ALPHABETICAL AND NUMERICAL, SHOWN FOR ASSEMBLY A8 ARE MARKED ON THE PRINTED CIRCUIT BOARD.
8. VOLTAGE MEASUREMENTS SHOWN IN RED ARE POSITIVE DC UNLESS OTHERWISE INDICATED AND ARE MEASURED WITH HEWLETT-PACKARD MODEL 410C VTVM, OR EQUIVALENT, CONNECTED WITH RESPECT TO CHASSIS GROUND. MEASUREMENT CONDITIONS NOTED BY ALPHABETICAL SUFFIX IN PARENTHESES ARE AS FOLLOWS:

   (A) 200-399 kHz
   (B) 400-799 kHz
   (C) 800-1, 699 kHz
   (D) 200, 400, 800 kHz (TYPICAL)
   (E) 300, 600, 1,200 kHz (TYPICAL)
   (F) 399, 799, 1,640 kHz (TYPICAL)
   (G) NO SIGNAL
   (H) INPUT SIGNAL = 1,000 μV/M
   (I) 200 kHz

NOTE: FROM LEFT TO RIGHT, CONTACTS ARE RELATED TO NUMBERS 10 THROUGH 1 PRINTED ON UNDERSIDE OF MOTHER BOARD A8.

TP40201

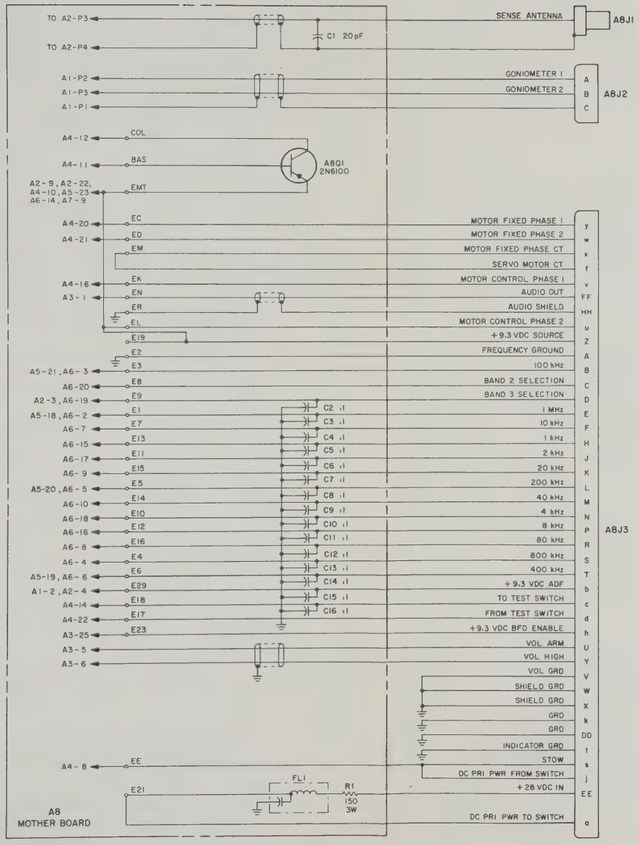
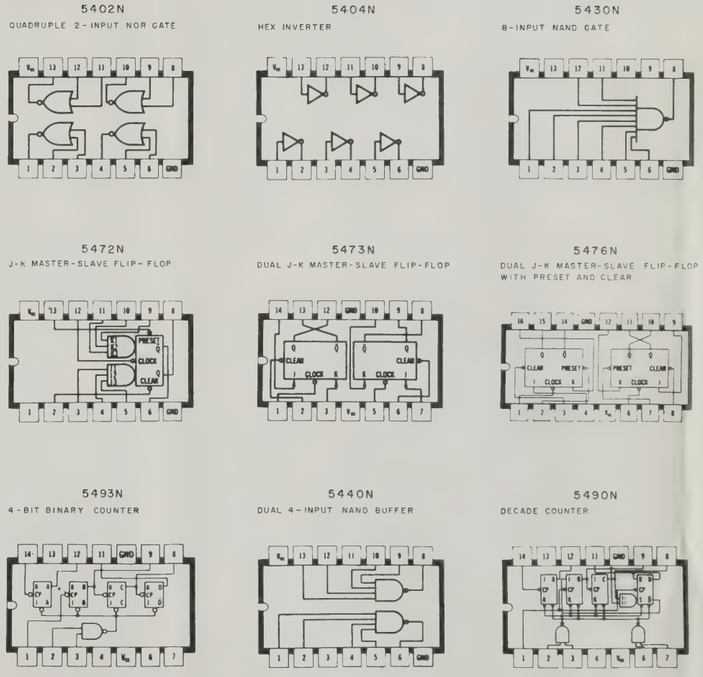
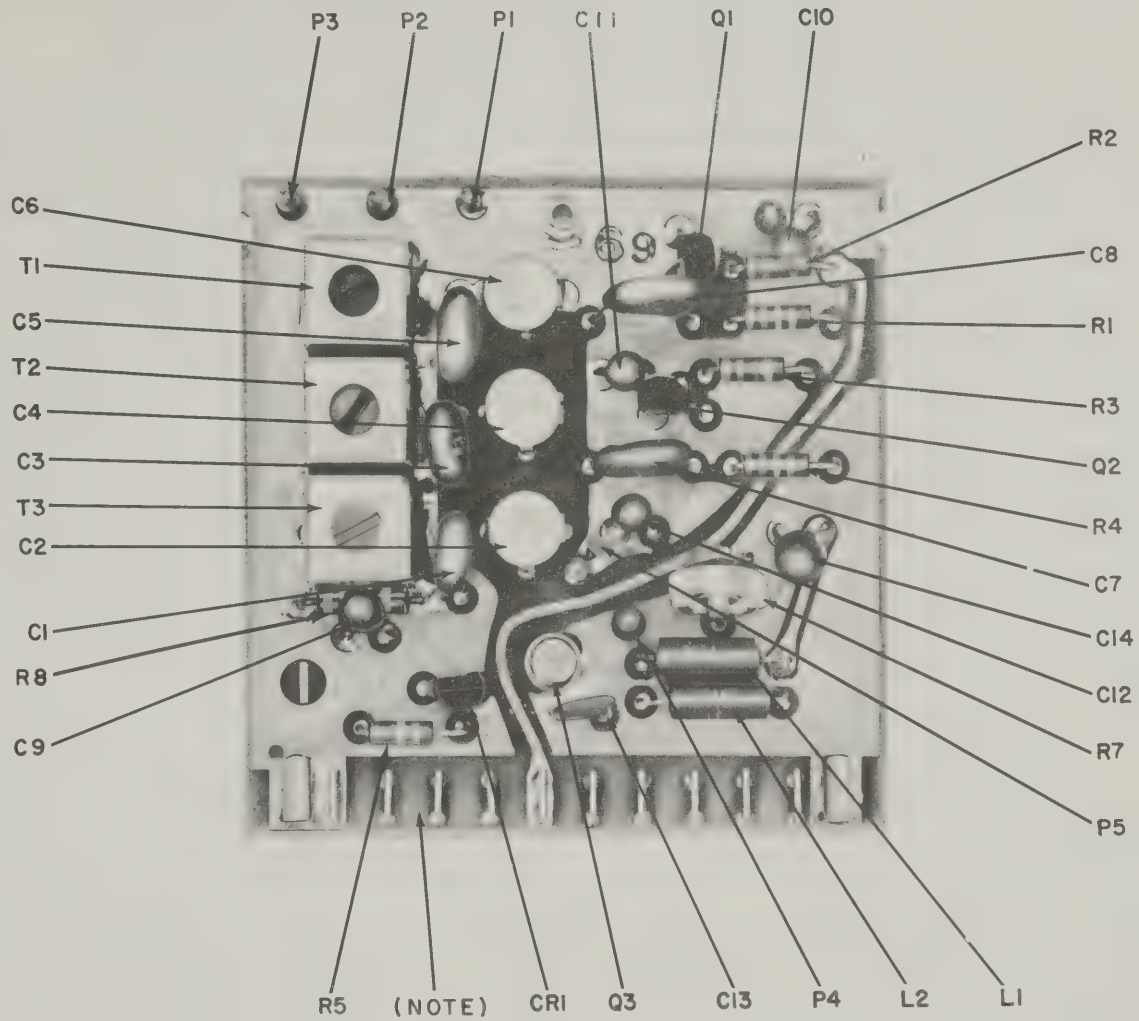


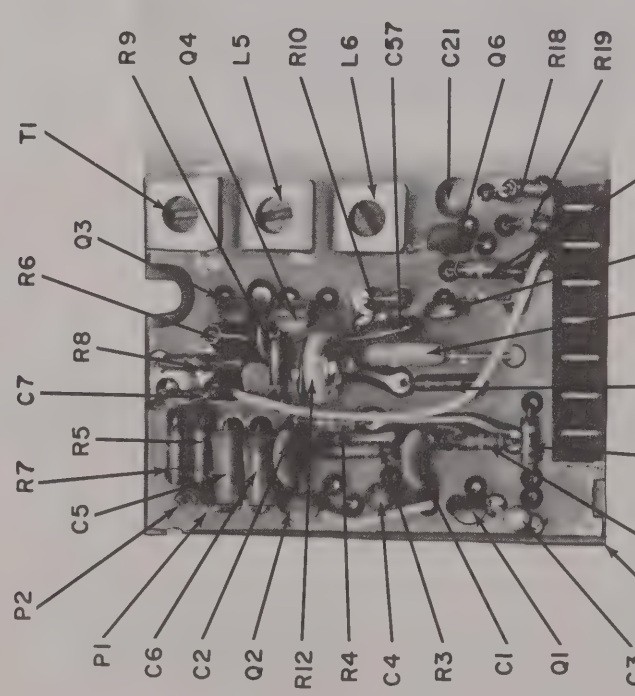
Figure 5-1. R-346A Receiver, Schematic Diagram (Sheet 4 of 4)





NOTE: FROM LEFT TO RIGHT, CONTACTS ARE RELATED TO NUMBERS 10 THROUGH 1 PRINTED ON UNDERSIDE OF MOTHER BOARD AND SHOWN ON FIGURE 5-1.

Figure 5-2. R-346A Receiver, A1, Loop Amplifier, Part Locations



NOTE: FROM LEFT TO RIGHT, CONTACTS ARE RELATED TO NUMBERS 1 THROUGH 15, 17, 18, AND 22 THROUGH 26 PRINTED ON UNDERSIDE OF MOTHER BOARD AND SHOWN ON FIGURE 5-1.

Figure 5-3. R-346A Receiver, A2, RF Amplifier, Part Locations (Sheet 1 of 3)

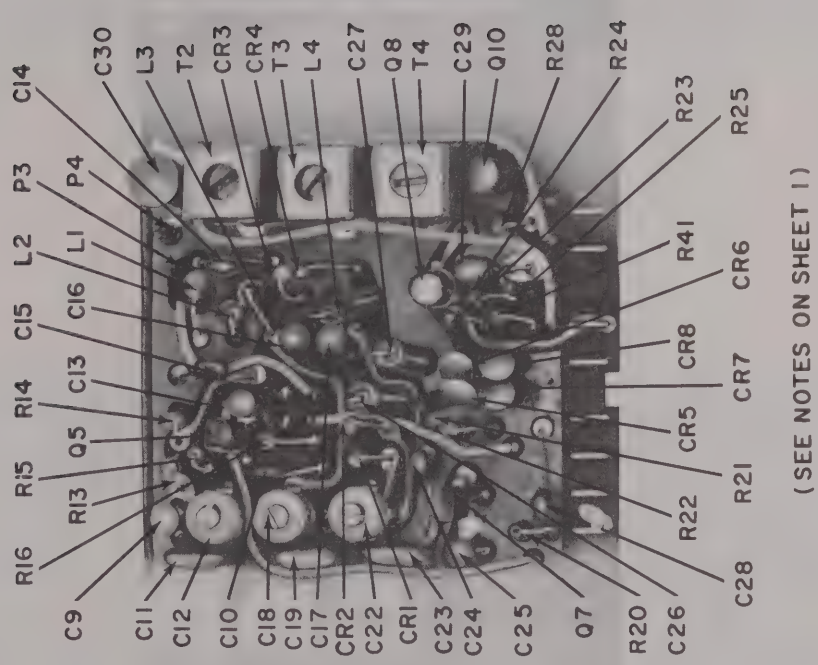


Figure 5-3. R-346A Receiver, A2, RF Amplifier, Part Locations (Sheet 2 of 3)

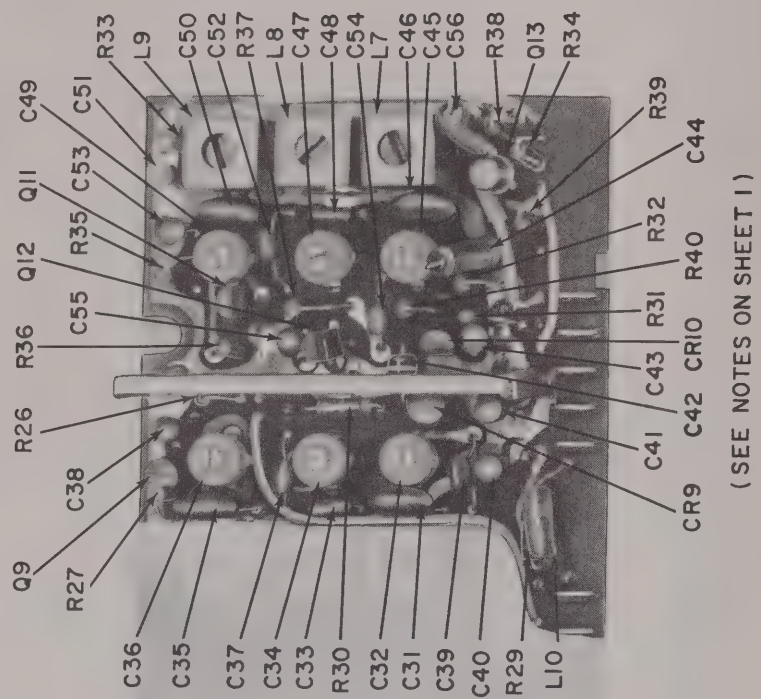
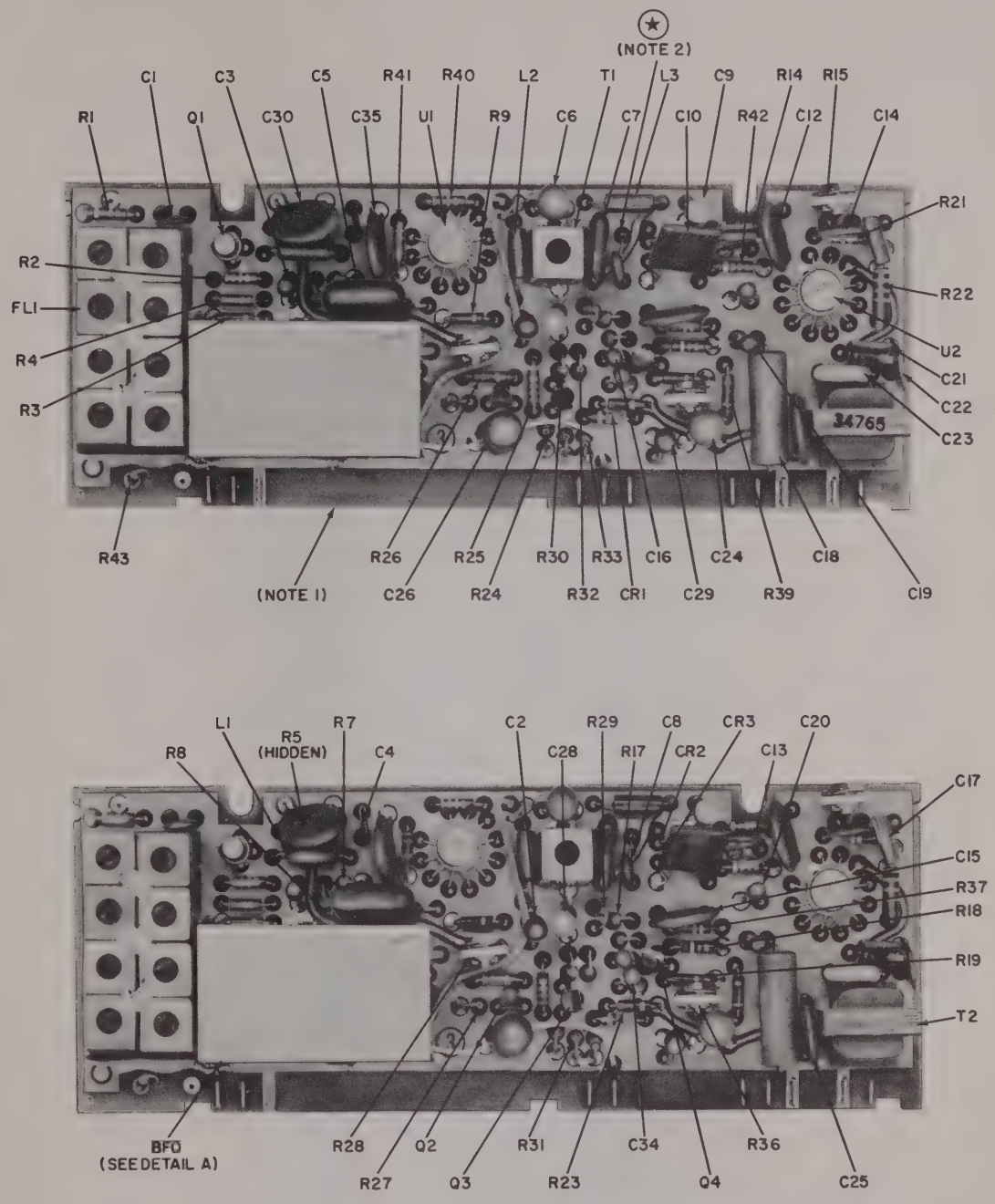
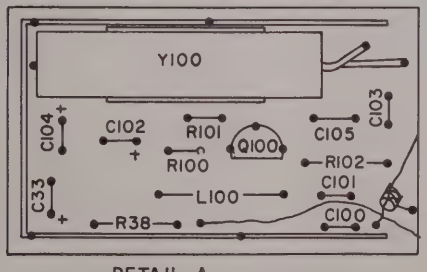


Figure 5-3. R-346A Receiver, A2, RF Amplifier, Part Locations (Sheet 3 of 3)



NOTES: 1. FROM LEFT TO RIGHT, CONTACTS ARE RELATED TO NUMBERS 26, 25, 24, 12, 11, 10, 6, 5, 4, 2, AND 1 PRINTED ON UNDERSIDE OF MOTHER BOARD AND SHOWN ON FIGURE 5-1.

2. A3T1, PIN 1 TIE POINT.



DETAIL A

Figure 5-4. R-346A Receiver, A3, IF Amplifier, Part Locations

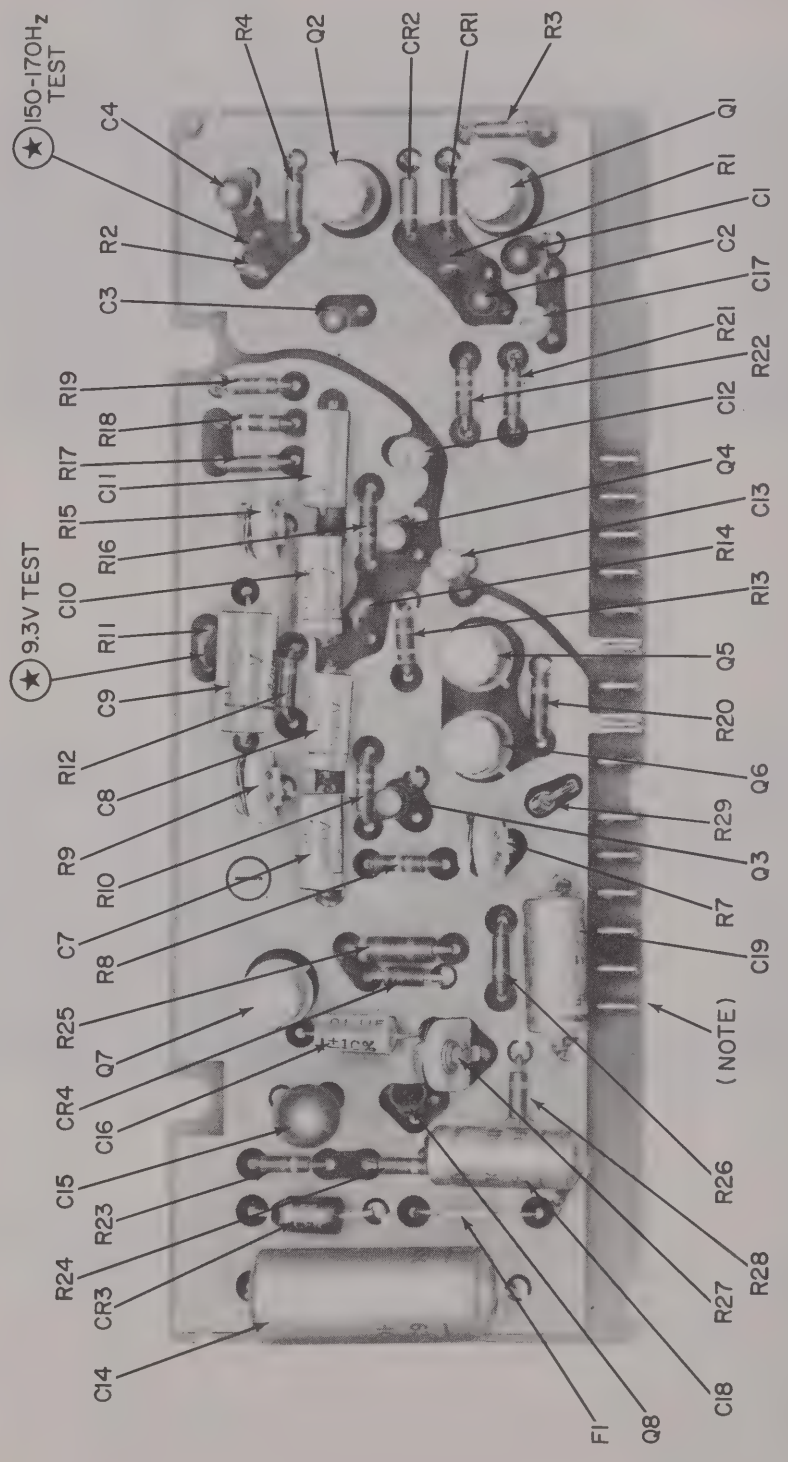
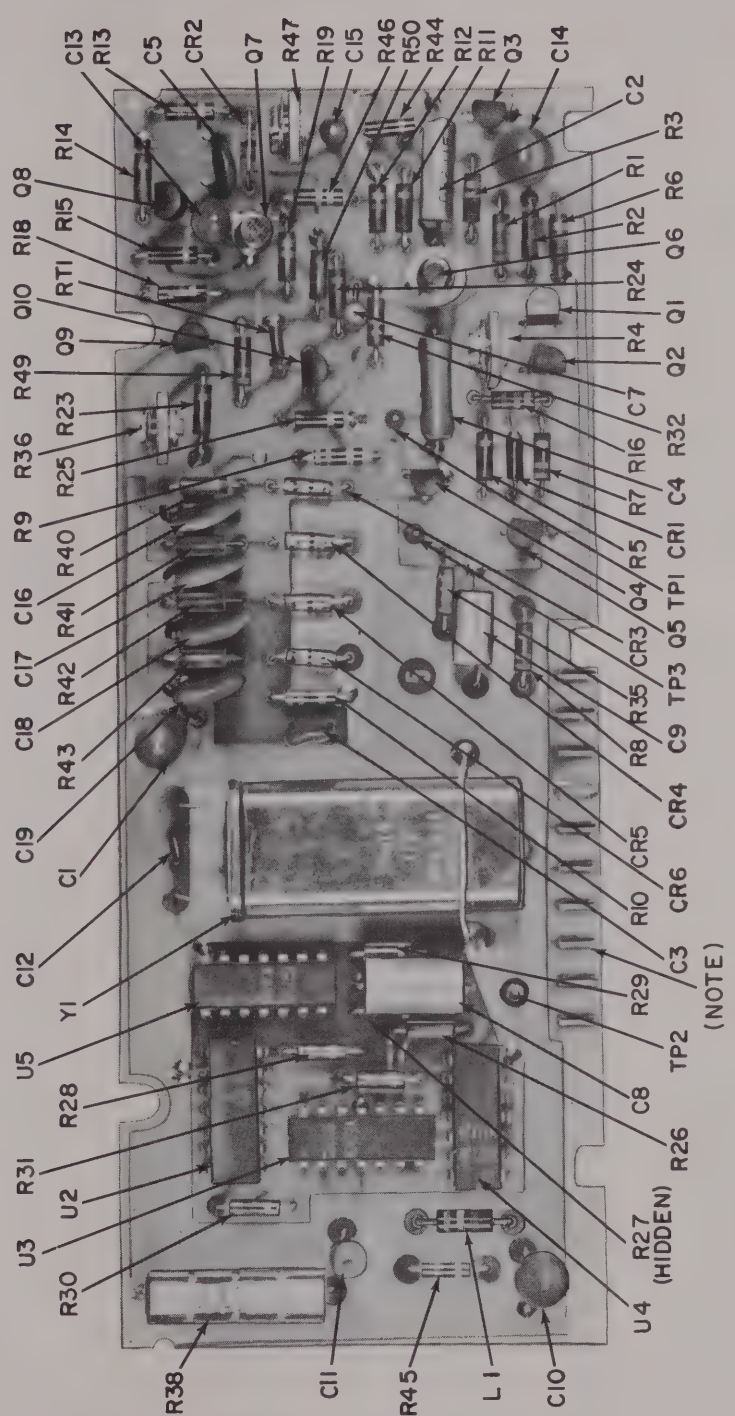


Figure 5-5. R-346A Receiver, A4, Servo Amplifier and Power Supply, Part Locations



NOTE:
FROM LEFT TO RIGHT, CONTACTS ARE RELATED TO NUMBERS 23 THROUGH 14 PRINTED ON UNDERSIDE OF MOTHER BOARD AND SHOWN ON FIGURE 5-1.

Figure 5-6. R-346A Receiver, A5, Phase Detector, Part Locations

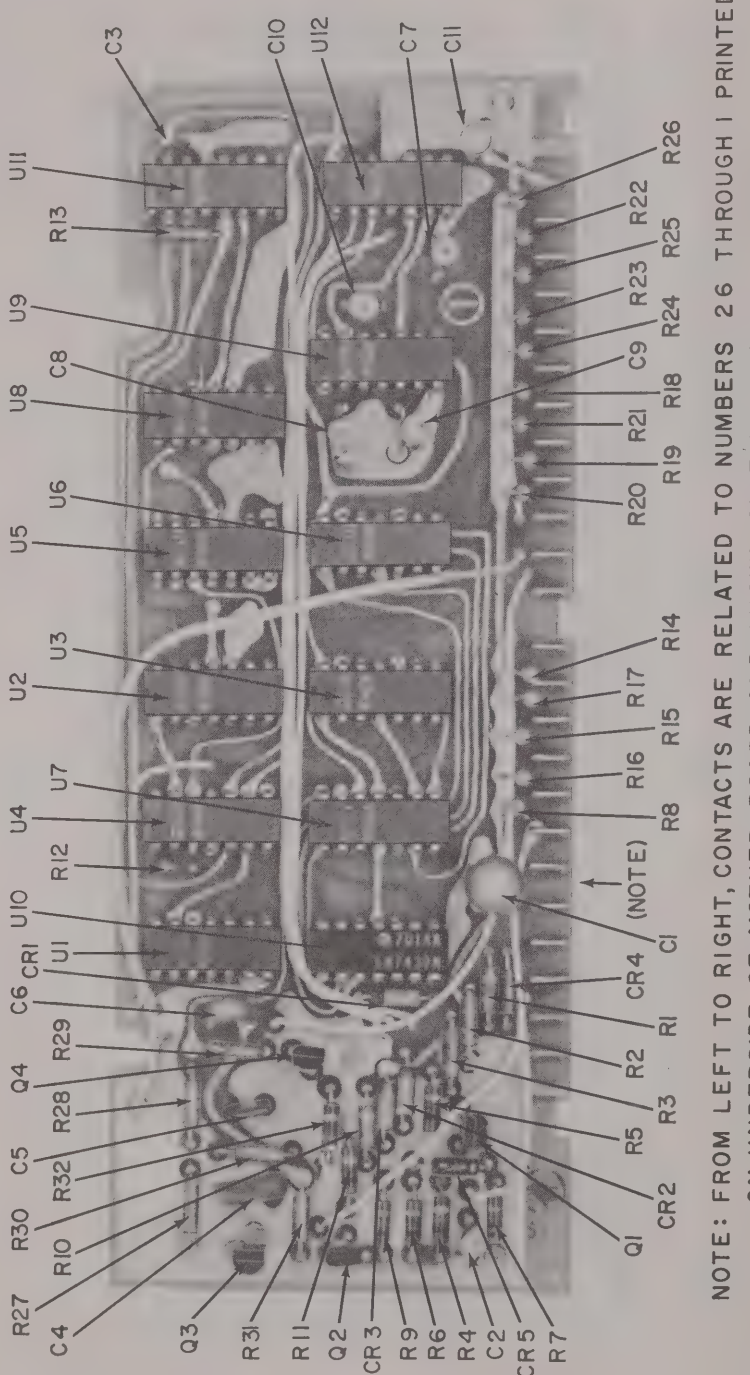


Figure 5-7. R-346A Receiver, A6, N Divider, Part Locations

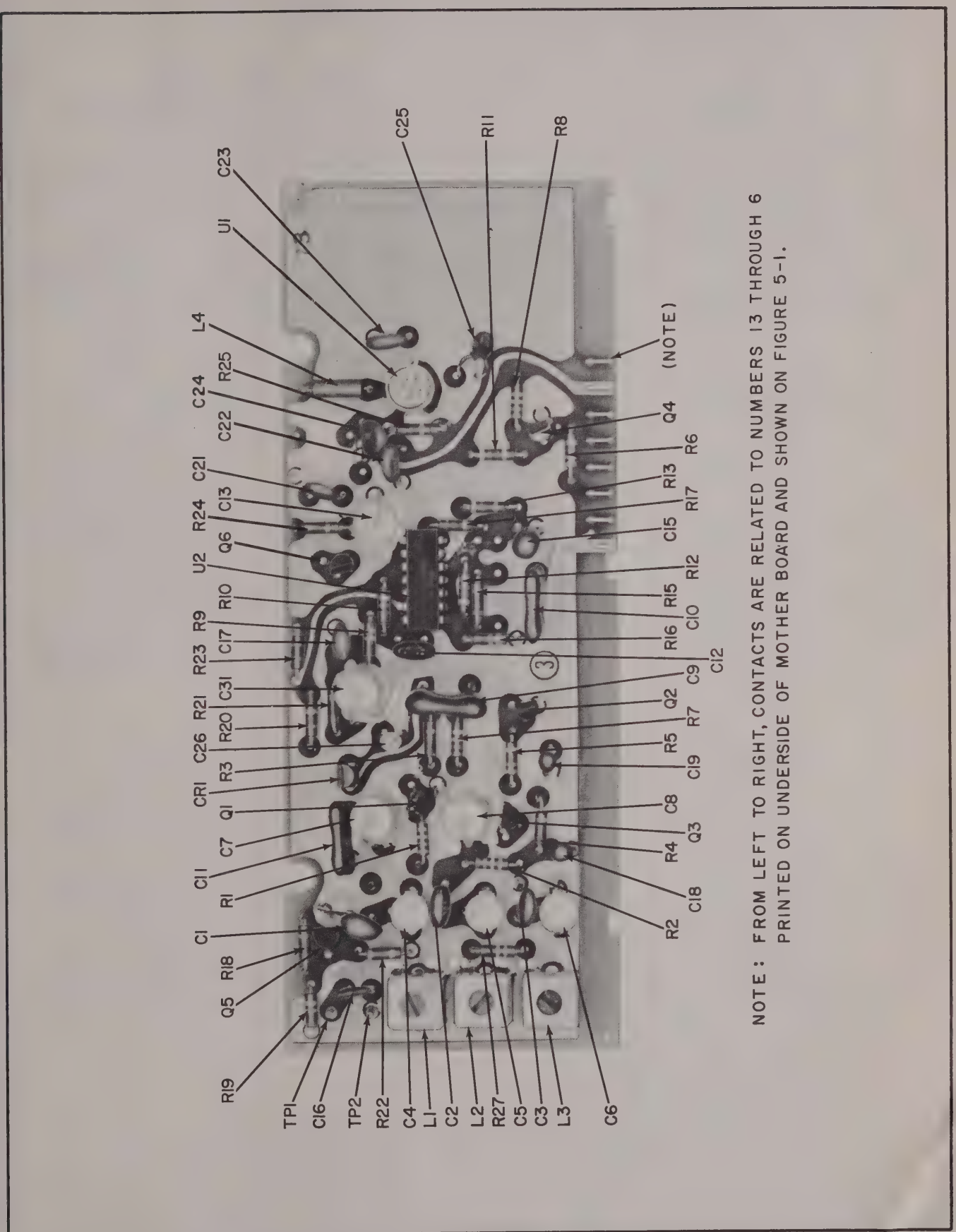


Figure 5-8. R-346A Receiver, A7, VCO (Voltage-Controlled Oscillator), Part Locations

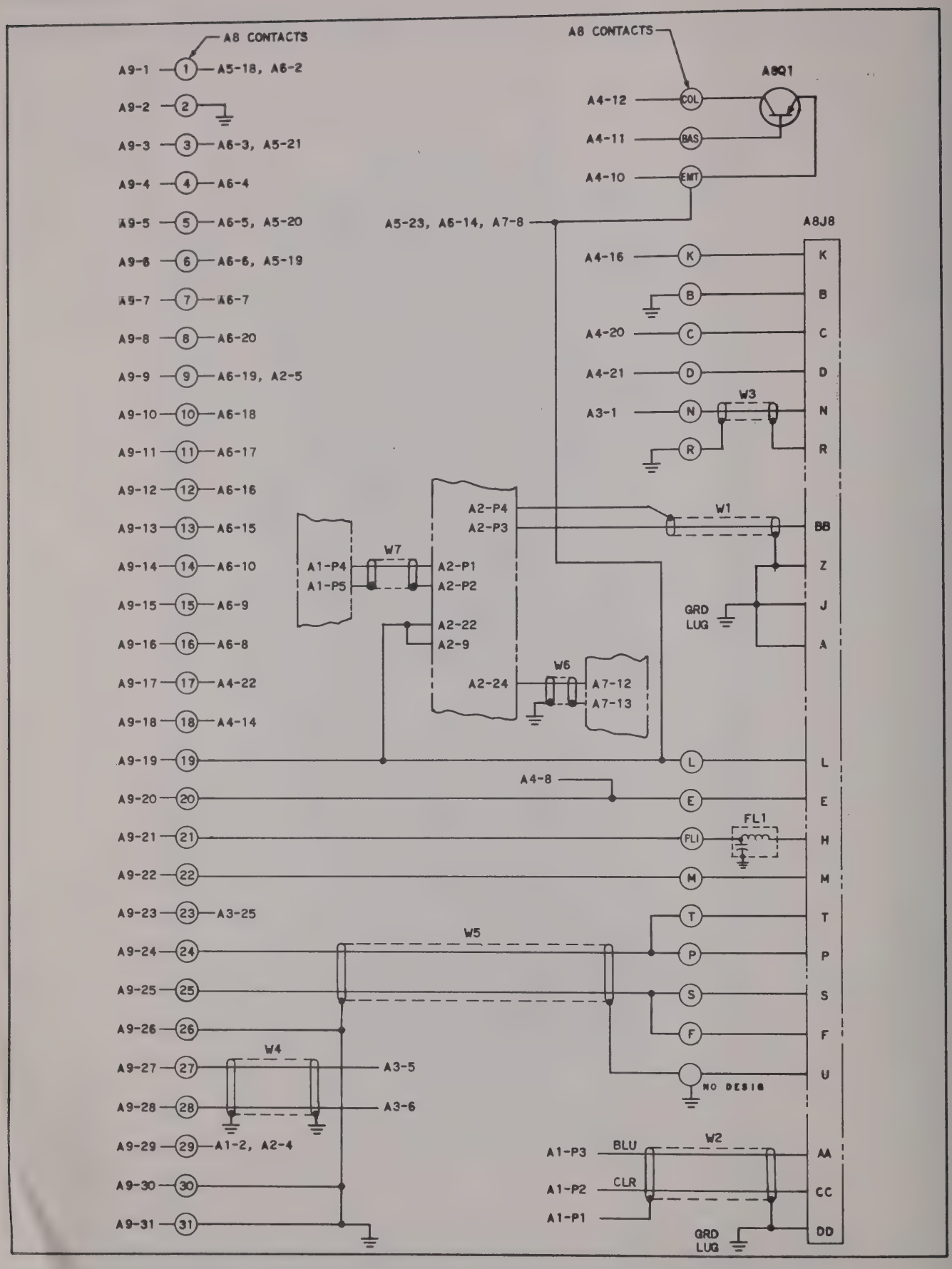
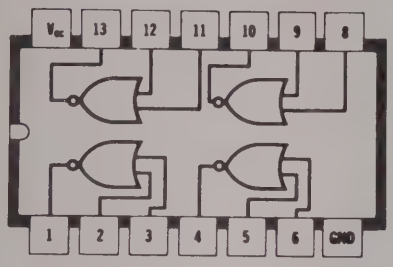


Figure 5-8A. R-346A Receiver, Mother Board Assembly A8, Schematic Diagram

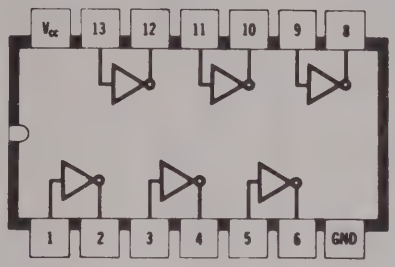
SN7402N

Quadruple 2-input NOR gate



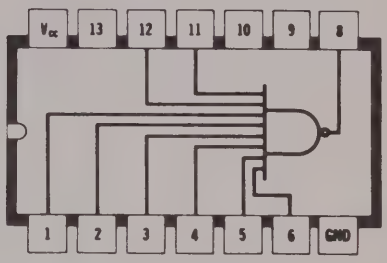
SN7404N

Hex inverter



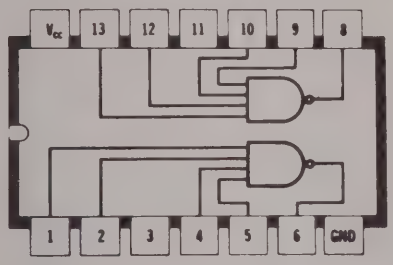
SN7430N

8-input NAND gate



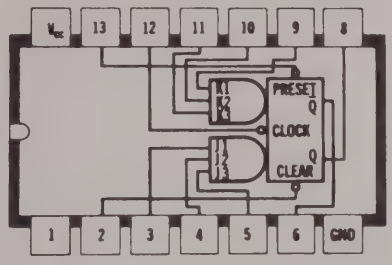
SN7440N

Dual 4-input NAND buffer



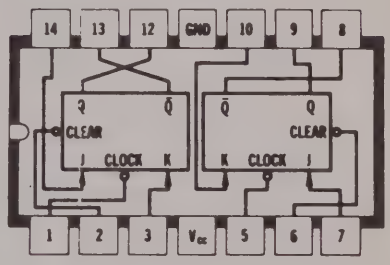
SN7472N

J-K master-slave flip-flop



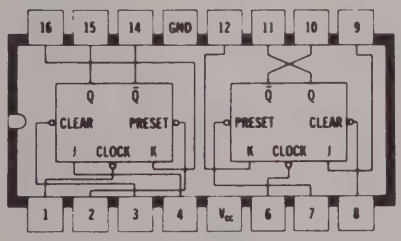
SN7473N

Dual J-K master-slave flip-flop



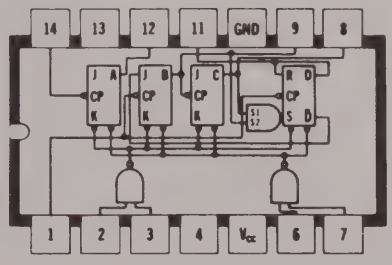
SN7476N

Dual J-K master-slave flip-flop with preset and clear



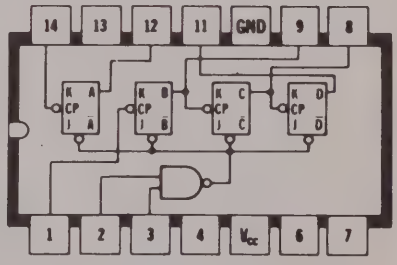
SN7490N

Decade counter



SN7493N

4-bit binary counter



Note

These integrated circuits are used in the A6, N Divider Module. Refer to Figure 5-1 (Sheet 3 of 4) for complete schematic of the A6, N Divider Module.

Figure 5-8B. Integrated Circuits (A6, N Divider), Schematic Diagram

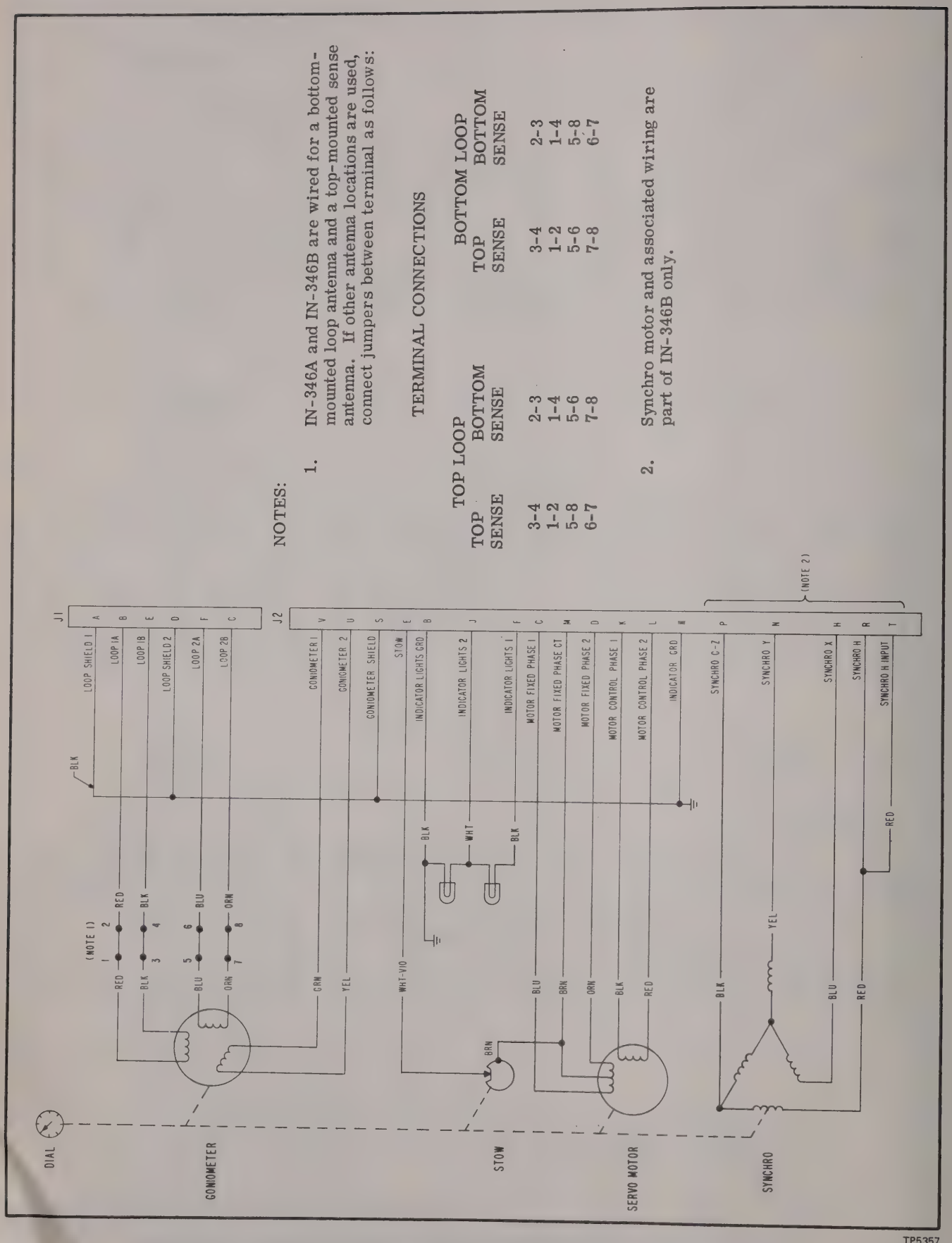


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Figure 5-8C. IN-346A and IN-346B Goniometer Indicators, Schematic Diagram

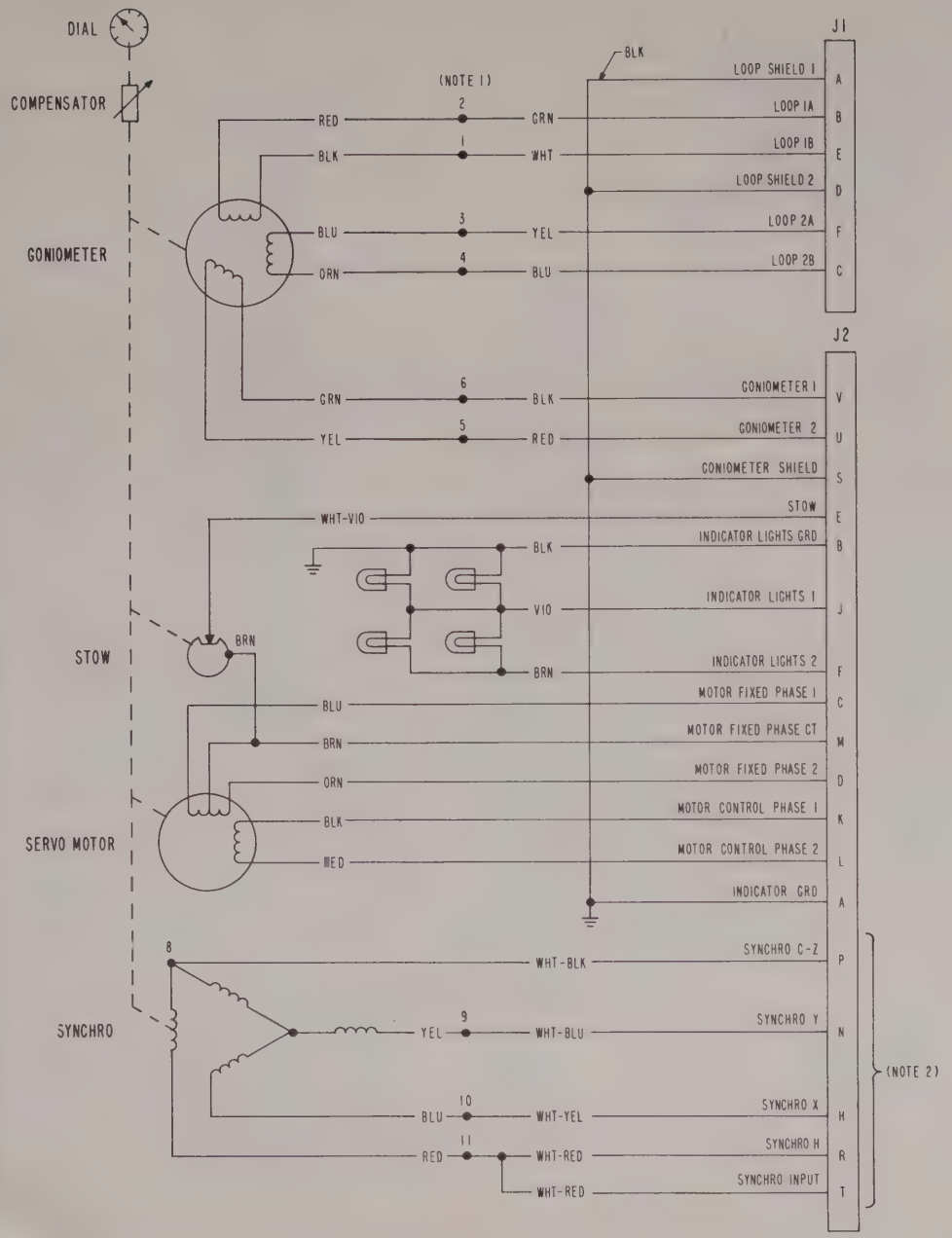


Figure 5-9. IN-346C and IN-346D Goniometer Indicators, Schematic Diagram

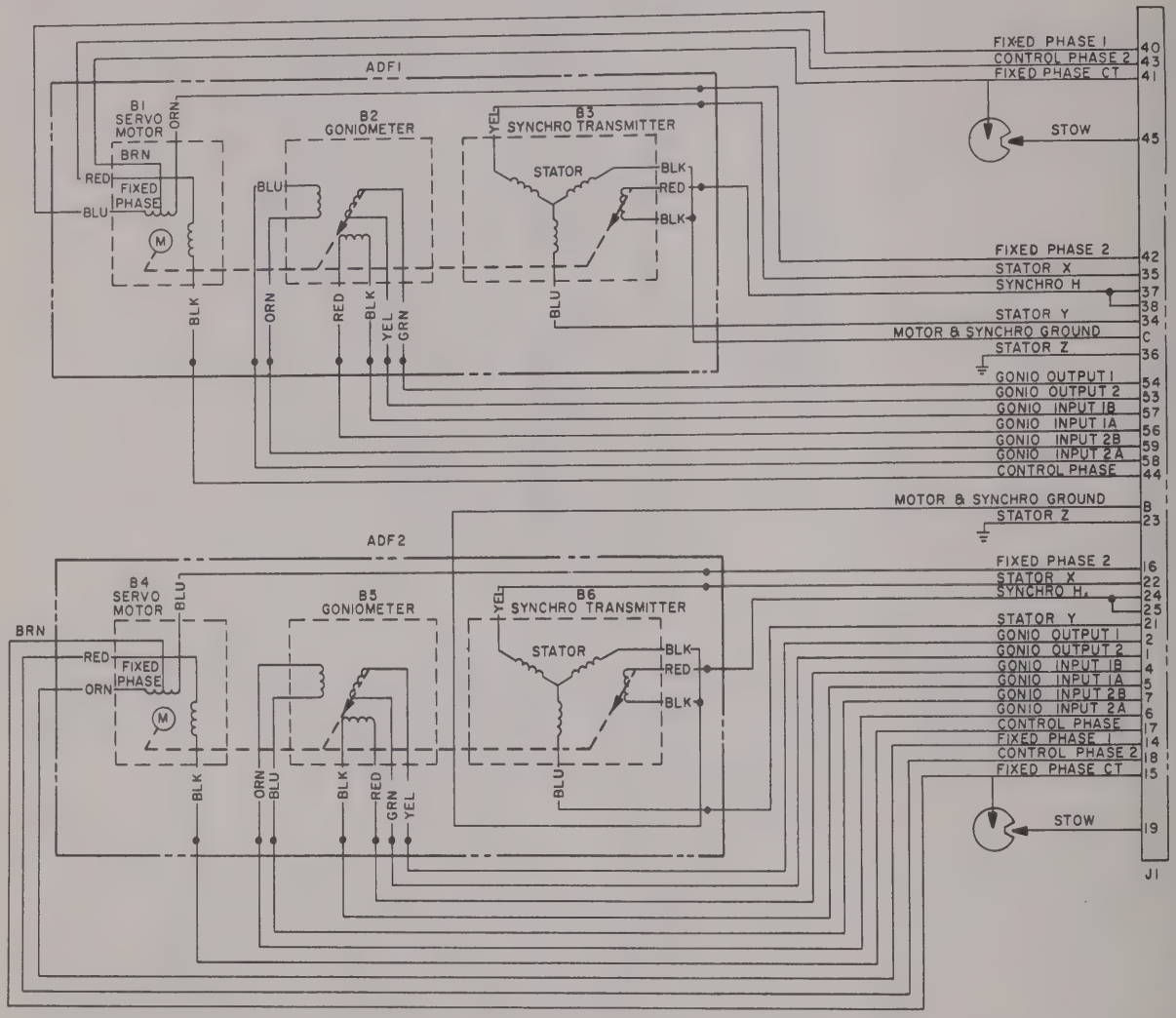
NOTES:

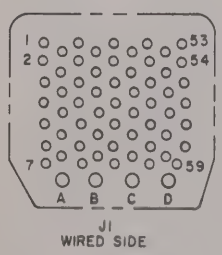
1. Goniometer connections shown are for a bottom-mounted loop antenna and a top-mounted sense antenna. If other antenna locations are used, reconnect goniometer wiring as follows:

TERMINAL NUMBER

WIRE COLOR	TOP LOOP TOP SENSE	TOP LOOP BOTTOM SENSE	BOTTOM LOOP TOP SENSE	BOTTOM LOOP BOTTOM SENSE
Red	6	5	5	6
Black	5	6	6	5
Green	1	1	2	2
White	2	2	1	1

2. Synchro motor and associated wiring are part of IN-346D only.

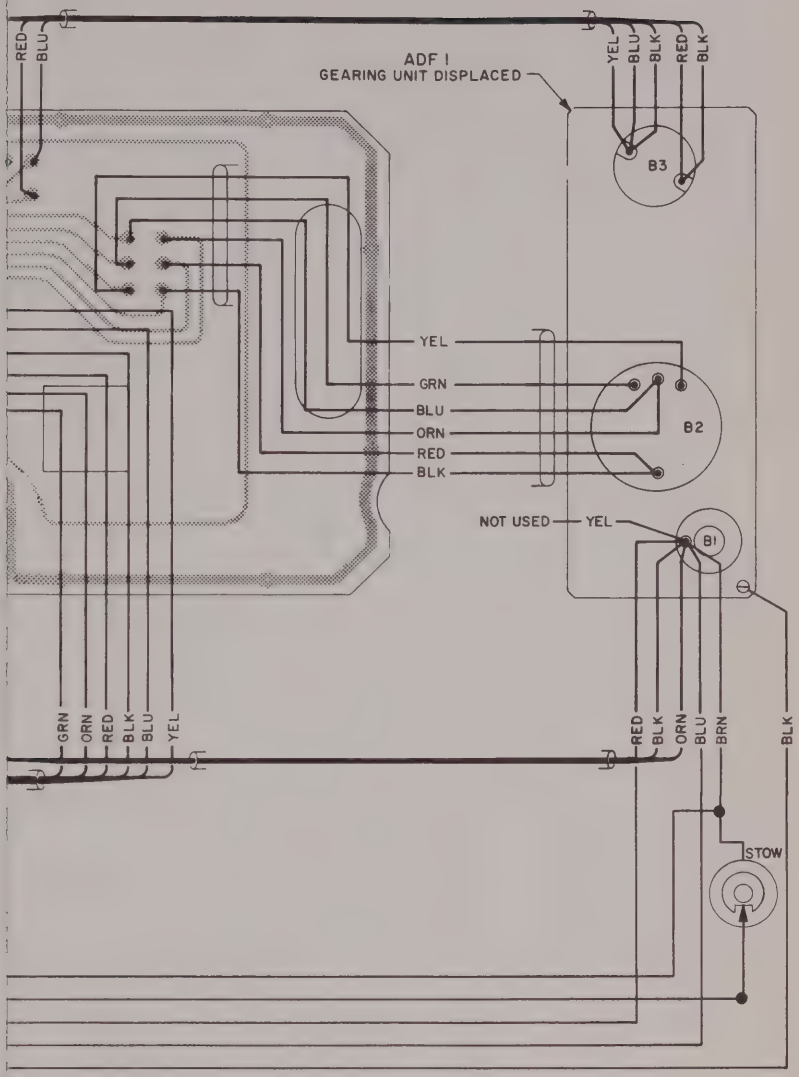




NOTES:

1. THE RA-346A AND THE RA-346B RECEIVER ACCESSORY UNITS ARE IDENTICAL EXCEPT FOR THE OMISSION OF THE ADF 2 MODULE AND ITS ASSOCIATED WIRING IN THE RA-346A.
2. J1C AND J1B ARE TIED TOGETHER AT BACK OF CONNECTOR.

Figure 5-10. RA-346A or RA-346B Receiver Accessory, Schematic Diagram



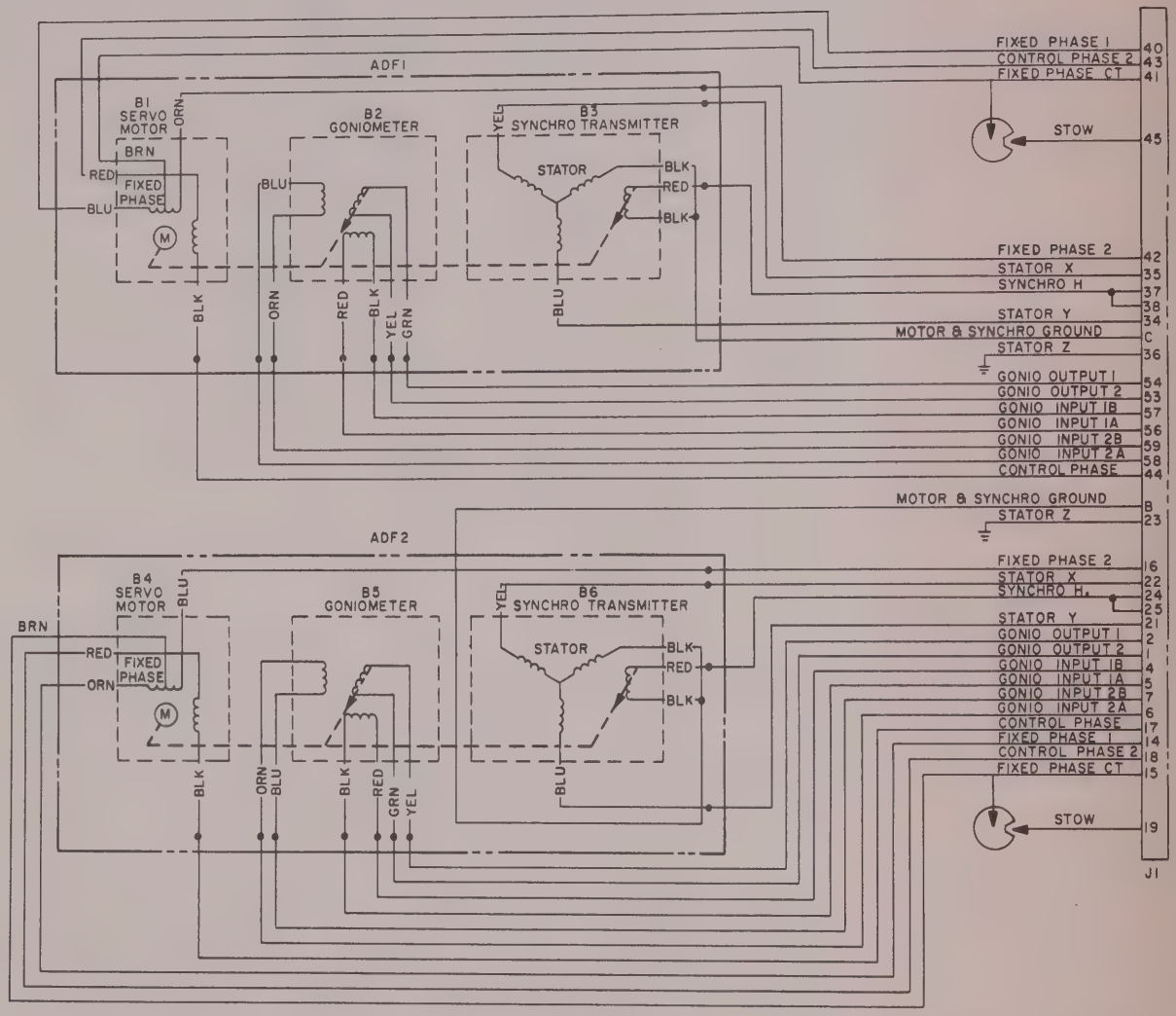
FOR ADF 1

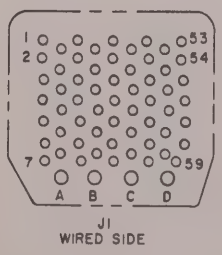
WIRE COLOR J1			CONNECTOR PIN NUMBERS			
			TOP LOOP		BOTTOM LOOP	
BODY	FIRST TCR	SECOND TCR	TOP SENSE	BOTTOM SENSE	TOP SENSE	BOTTOM SENSE
WHITE	BLACK	GRAY	57	57	56	56
WHITE	BLACK	GREEN	56	56	57	57
WHITE	BLACK	RED	54	53	53	54
WHITE	BLACK	BROWN	53	54	54	53

FOR ADF 2

WIRE COLOR J1		CONNECTOR PIN NUMBERS			
		TOP LOOP		BOTTOM LOOP	
BODY	TCR	TOP SENSE	BOTTOM SENSE	TOP SENSE	BOTTOM SENSE
WHITE	GRAY	5	5	4	4
WHITE	GREEN	4	4	5	5
WHITE	RED	2	1	1	2
WHITE	BROWN	1	2	2	1

RA-346B Receiver Accessory, Wiring Diagram

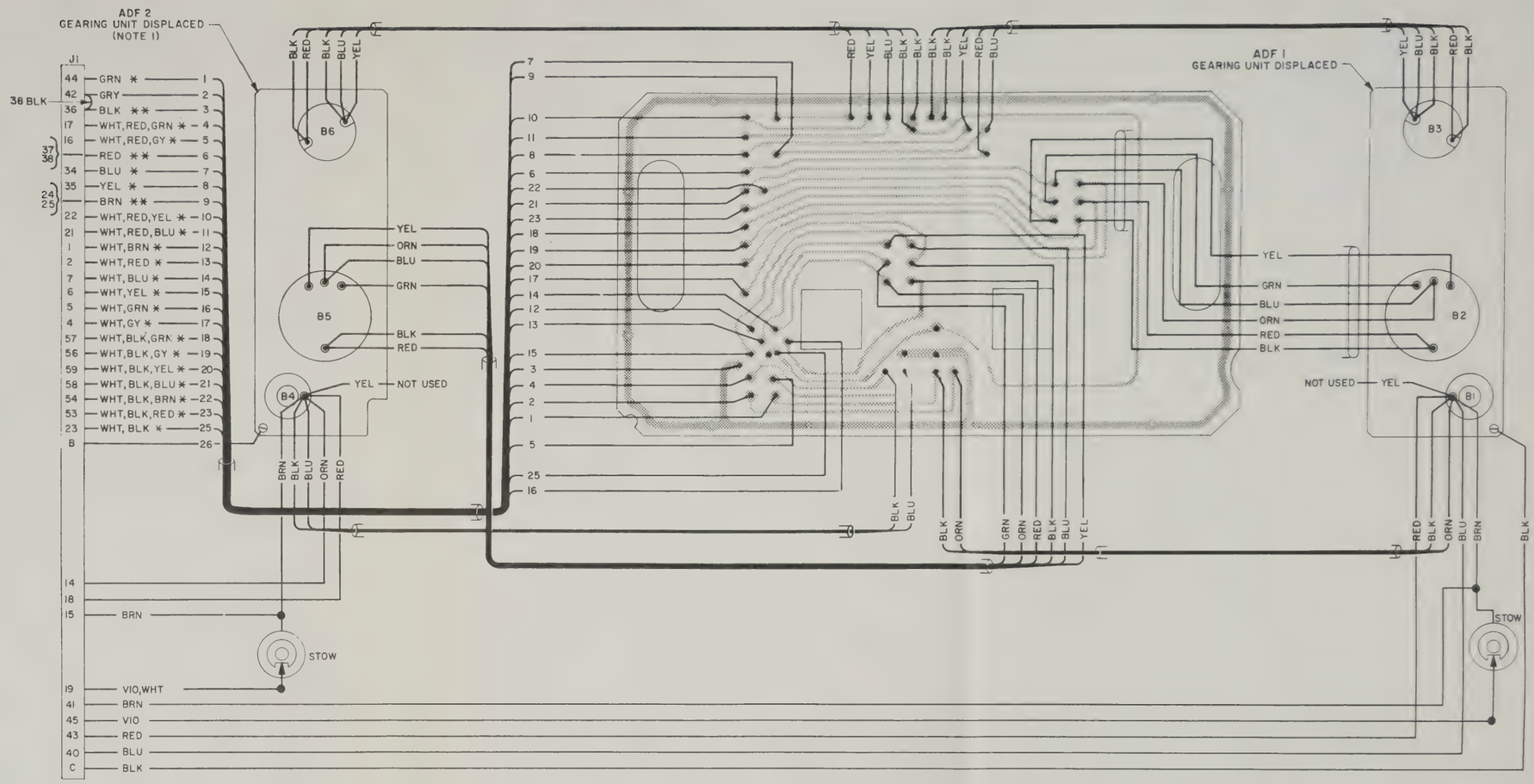




NOTES:

1. THE RA-346A AND THE RA-346B RECEIVER ACCESSORY UNITS ARE IDENTICAL EXCEPT FOR THE OMISSION OF THE ADF 2 MODULE AND ITS ASSOCIATED WIRING IN THE RA-346A.
2. J1C AND J1B ARE TIED TOGETHER AT BACK OF CONNECTOR.

Figure 5-10. RA-346A or RA-346B Receiver Accessory, Schematic Diagram



NOTES:

1. THE RA-346A AND RA-346B ACCESSORY UNITS ARE IDENTICAL EXCEPT FOR THE OMISSION OF THE ADF 2 MODULE AND ITS ASSOCIATED WIRING IN THE RA-346A.
2. FOR SCHEMATIC DIAGRAM, SEE FIGURE 5-10.
3. WIRES MARKED WITH COLOR NOTE ARE PART OF COMPONENT. WIRES MARKED WITH COLOR NOTE AND ASTERISK (*) ARE NO. 24 AWG STRANDED COPPER, TEFLON INSULATED. WIRES MARKED WITH DOUBLE ASTERISK (**) ARE NO. 20 AWG STRANDED COPPER, TEFLON INSULATED.
4. VINYLITE TUBING OF APPROPRIATE SIZE INSTALLED OVER WIRES MARKED ⊖
5. SHADED AREAS DENOTE UNETCHED COPPER.
6. THE ACCESSORY UNITS ARE WIRED FOR A BOTTOM-MOUNTED LOOP ANTENNA AND TOP-MOUNTED SENSE ANTENNA. IF OTHER ANTENNA LOCATIONS ARE USED, REWIRE J1 AS INDICATED IN THE ACCOMPANYING TABLE. THE CONTACTS OF J1 MAY BE REMOVED USING TOOL W-11, PART NO. 22001,TO REPLACE. PRESS CONTACTS INTO APPROPRIATE CONNECTOR TERMINALS.

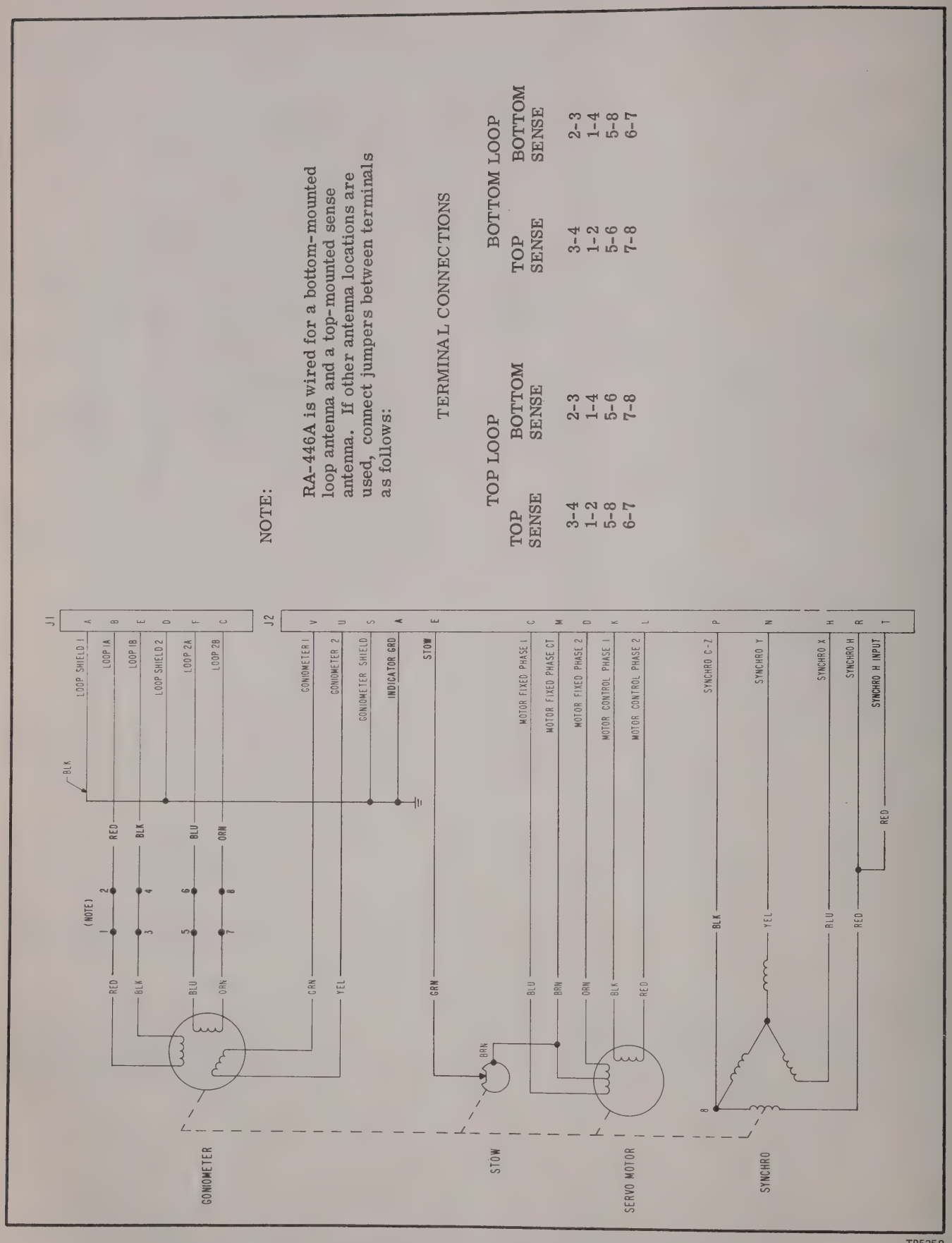
FOR ADF 1

WIRE COLOR J1			CONNECTOR PIN NUMBERS			
			TOP LOOP		BOTTOM LOOP	
BODY	FIRST TCR	SECOND TCR	TOP SENSE	BOTTOM SENSE	TOP SENSE	BOTTOM SENSE
WHITE	BLACK	GRAY	57	57	56	56
WHITE	BLACK	GREEN	56	56	57	57
WHITE	BLACK	RED	54	53	53	54
WHITE	BLACK	BROWN	53	54	54	53

FOR ADF 2

WIRE COLOR J1		CONNECTOR PIN NUMBERS			
		TOP LOOP		BOTTOM LOOP	
BODY	TCR	TOP SENSE	BOTTOM SENSE	TOP SENSE	BOTTOM SENSE
WHITE	GRAY	5	5	4	4
WHITE	GREEN	4	4	5	5
WHITE	RED	2	1	1	2
WHITE	BROWN	1	2	2	1

Figure 5-11. RA-346A or RA-346B Receiver Accessory, Wiring Diagram



TP5359

Figure 5-11A. RA-446A Receiver Accessory, Schematic Diagram

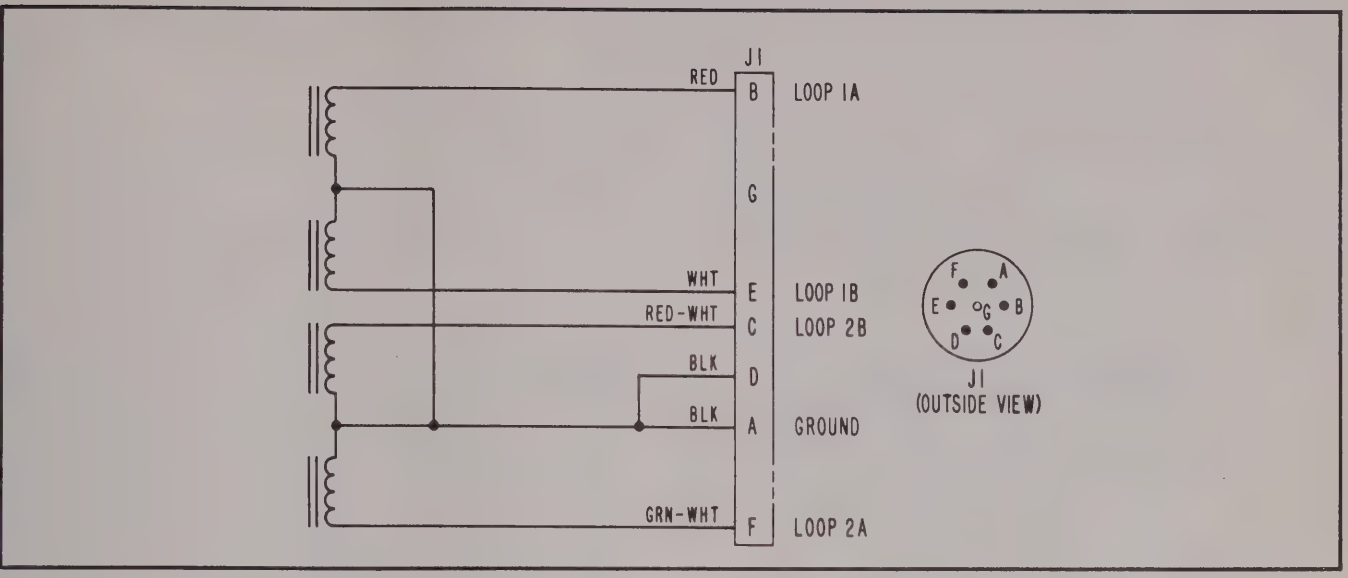
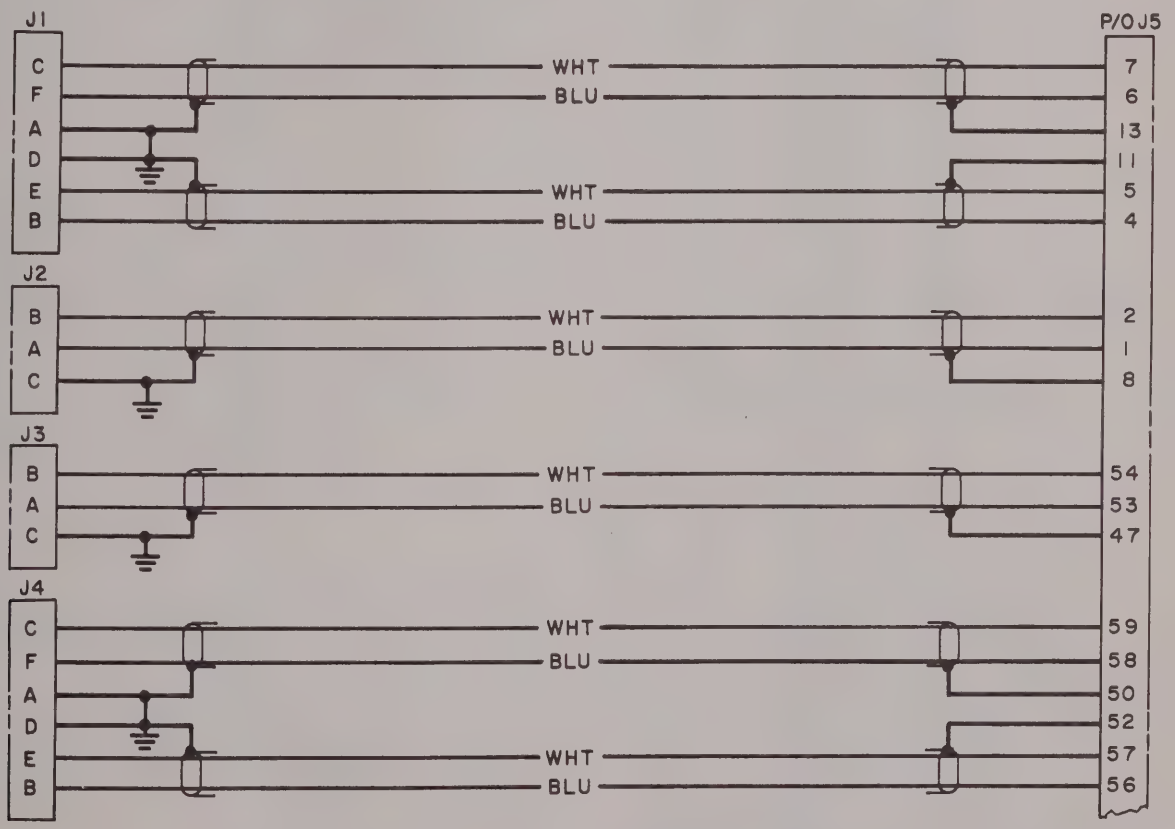
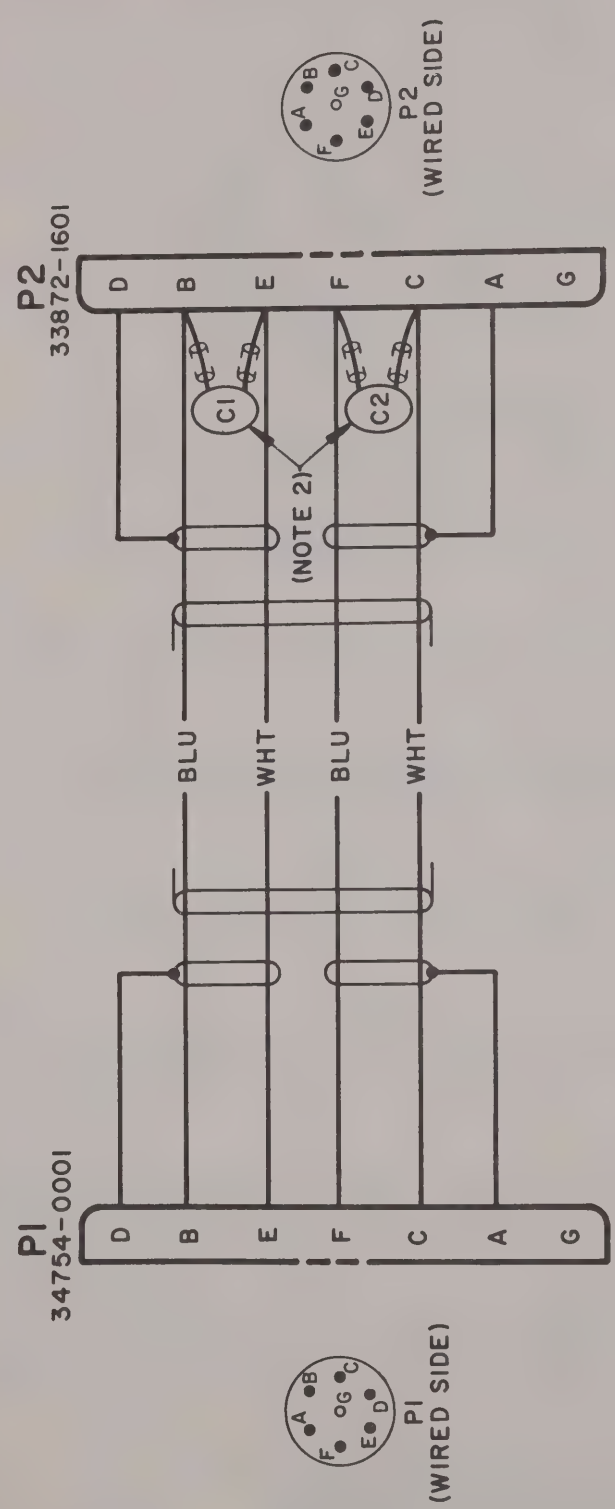


Figure 5-12. L-346A Loop Antenna, Schematic Diagram



NOTE: BLUE AND WHITE WIRES ARE TWISTED, AND ENCLOSED IN GROUNDED SHIELDING AND TEFLON TUBING. PLACEMENT OF WIRING IS CRITICAL; DO NOT REARRANGE.

Figure 5-13. M-59B Mounting, Wiring Diagram



NOTES:

1. LENGTH OF CABLE ASSEMBLY IS CRITICAL AND MUST NOT BE ALTERED. WIRES ARE NO. 30 AWG STRANDED COPPER, TEFLON INSULATED.
2. C1 AND C2 ARE PART OF 33827.

Figure 5-14. Loop Cable Assemblies, Part No. 33827 and 32803, Wiring Diagram

SECTION VI

PARTS LISTS

6-1. INTRODUCTION.

This section lists and describes the replaceable parts for the units of the Cessna 400 ADF Set.

6-2. PARTS LISTS.

The electrical parts for the R-346A Receiver Accessory and the parts for the M-59B Mounting are listed in an alphabetical-numerical sequence of the reference designations assigned to the parts on the schematic diagrams. The reference designations as shown are abbreviated; for the complete designation, prefix the designation shown with the assembly designation included at the beginning of each list. For example, the complete reference designation for C4 in VCO Module A7 would be A7C4. The location of a part by its reference designation may be determined by referring to the applicable component location or wiring diagram, Figures 5-2 through 5-8 for the R-346A and Figure 5-13 for M-59B. Within each assembly parts list, complete information is given for a part listed for the first time. Subsequent listings of the same part with the same assembly are referenced back to the original listing.

The mechanical parts for the receiver and the parts for the goniometer-indicators and receiver accessory units are listed in a recommended order of disassembly, except for attaching parts which are listed directly after the part attached. Index numbers are assigned in sequence to each part and are keyed to exploded view illustrations, Figures 6-1 through 6-6. For cross-reference, a part number numerical index and a reference designation index related to these parts lists are included at the end of this section.

6-3. MANUFACTURERS' CODES AND PART NUMBERS.

Cessna part numbers are listed in a separate column in the parts lists. Other manufacturers' part numbers are identified by the manufacturer's numerical code (based on the Federal Supply Code for Manufacturers) and the manufacturer's part number enclosed within parentheses at the end of the part description or listed in a separate column. The numerical codes used in the parts lists and the names and addresses of the manufacturers are as follows:

Code	Name and Address
YYYYY	F-Dyne Electronics Corp. Fairfield, Connecticut 06430
01121	Allen-Bradley Co. 1201 South 2nd Street Milwaukee, Wisconsin 53204
01295	Texas Instruments Inc. Semiconductor-Components Division 13500 North Central Expressway Dallas, Texas 75231
02660	Amphenol Corporation 2801 South 25th Avenue Broadview, Illinois 60153
03508	General Electric Company Semiconductor Products Dept. Electronics Park Syracuse, New York 13201
04713	Motorola Semiconductor Products, Inc. 5005 East McDowell Road Phoenix, Arixona 85008
08530	Reliance Mica Corporation 342 39th Street Brooklyn, New York 11201
08806	General Electric Company Miniature Lamp Dept. Cleveland, Ohio 44112
11413	Hughes Aircraft Company Industrial Systems 5261 West Imperial Highway Los Angeles, California 90009
12639	Northfield Precision Instrument Corp. 4400 Austin Boulevard Island Park, L.I., New York 11558
13327	Solitron Devices Inc. 256 Oak Tree Road Tappan, New York 10983
14936	General Instrument Corp. Semi-Conductor Division 600 West John Street Hicksville, L.I., New York 11802
15450	Erie Technological Products Inc. Electronics Division 644 West 12th Street Erie, Pennsylvania 16512
22921	Master Dynamics Corporation Division of Master Specialities Co. 165 San Lazaro Avenue Sunnyvale, California 94086
28308	Scot Incorporated 2525 Curtiss Street Downers Grove, Illinois 60515

Code	Name and Address
28965	Trush Co., U.S. Agent Stittner and Co. Box 66 Cazenovia, N. Y. 13035
44655	Ohmite Manufacturing Co. 3601 Howard Street Skokie, Illinois 60076
54753	General Instrument Corporation F. W. Sickles Division 125 Front Street Chicopee, Mass. 01014
56289	Sprague Electric Co. 367 Marshall Street North Adams, Massachusetts 01247
72136	The Electromotive Mfg. Co., Inc. South Park and John Streets Willimantic, Conn. 06226
73445	Amperex Electronic Corporation 230 Duffy Avenue Hicksville, L.I., New York 11801
75915	Littelfuse Incorporated 800 East Northwest Highway Des Plaines, Illinois 60016
76055	Mallory Controls Company Division of P. R. Mallory and Co., Inc. State Road 28 West Frankfort, Indiana 46041
78189	Illinois Tool Works Inc. Shakeproof Division Elgin, Illinois 60126
78488	Stackpole Carbon Company St. Marys, Pennsylvania 15857
78553	Tinnerman Products Inc. Cleveland, Ohio 44101
79136	Waldes Kohinor Inc. Long Island City, New York 11101
80294	Bourns Incorporated 6135 Magnolia Avenue Riverside, California 92502
81312	Winchester Electronics Division of Litton Industries, Inc. Oakville, Connecticut 06779
84411	TRW Incorporated Capacitor Division 112 West First Street Ogallala, Nebraska 69153
86684	Radio Corporation of America Electronic Components and Devices Harrison, New Jersey 07029
88818	Kearfott Division Singer-General Precision Inc. 1500 McBride Avenue Little Falls, New Jersey 07424
89944	Kollsman Instrument Corporation Syosset, L.I., New York 11791
93332	Sylvania Electric Products Inc. Semiconductor Products Division 100 Sylvan Road Woburn, Massachusetts 01801
95263	Leecraft Manufacturing Co., Inc. 21-16 44th Road Long Island City, New York 11101
96881	Thomson Industries Inc. New Hyde Park, L.I., New York 11040
97622	Gladding-Keystone Corporation Union City, New Jersey 07087
97913	Industrial Electronic Hardware Corp. 109 Prince Street New York, New York 10012

Reference Designation	Description	Part No.	Manufacturer And Part No.
LOOP MODULE A1 (Part No. 41144)			
CR1	SEMICONDUCTOR DEVICE, Diode (Selected)	41075-0001 41075-0002 41075-0003 41075-0004 41075-0005	
C1	CAPACITOR, Fixed, mica, (Selected) ± 10 percent, 50 Vdc	37967-XXXX	
C2	CAPACITOR, Variable, rotary, ceramic, 4.5 to 20 pF min. + 10 percent, max - 10 percent plus 50 percent, 160 Vdc	34676-0004	28965 7S-TR1KO-02 4.5/20pFN750
C3	CAPACITOR, Fixed, mica, (Selected) ± 10 percent, 50 Vdc	37967-XXXX	
C4	Same as C2		
C5	CAPACITOR, Fixed, mica, (Selected) ± 10 percent, 50 Vdc	37967-XXX	
C6	Same as C2		
C7	CAPACITOR, Fixed, ceramic, 0.1uF ±20%, 18 Vdc	41915-0104	
C8	Same as C7		
C9	CAPACITOR, Fixed, tantalum, 1.0 uF ± 20 percent, 35 Vdc	40248-2074	56289 196D105X-0035HA1
C10	Same as C9		
C11	Same as C9		
C12	Same as C9		
C13	CAPACITOR, Fixed, ceramic, 1000 pF ± 10 percent, 200 Vdc	30949-0102	15450
C14	CAPACITOR, Fixed, tantalum, 10 uF ± 20 percent, 20 Vdc	40248-2211	56289 196D106X-0020JA1
L1	INDUCTOR, R.F., Shielded, 10,000 uH ± 10 percent	34614-1103	
L2	INDUCTOR, R.F., Shielded, 1,000 uH ± 10 percent	34614-1102	
Q1	TRANSISTOR, Silicon, NPN	36961-4124	04713 2N4124
Q2	Same as Q1		
Q3	TRANSISTOR, FET	39903	14936 MEM571C
R1	RESISTOR, Fixed, composition, 330,000 ohms ± 10 percent, 1/4 watt	200-0334	01121 CB3341

Reference Designation	Description	Part No.	Manufacturer And Part No.
	LOOP MODULE A1 (Cont)		
R2	RESISTOR, Fixed, composition, 330 ohms ± 10 percent, 1/4 watt	200-0331	01121 CB3311
R3	Same as R2		
R4	Same as R1		
R5	RESISTOR, Fixed, composition, 100,000 ohms ± 10 percent, 1/4 watt	200-0104	01121 CB1041
R6	NOT USED		
R7	RESISTOR, Variable, 100 ohms ± 20 percent, 1/2 watt	40878-1101	80294 3359W
R8	RESISTOR, Fixed, composition, 82,000 ohms ± 10 percent, 1/4 watt	200-0823	01121 CB8231
T1	TRANSFORMER, R.F., Loop	41074-0001	54753 EX22811
T2	TRANSFORMER, R.F., Loop	41074-0002	54753 EX22812
T3	TRANSFORMER, R.F., Loop	41074-0003	54753 EX22593

Reference Designation	Description	Part No.	Manufacturer And Part No.
R. F. MODULE A2 (Part No. 41156-0000)			
CR1	SEMICONDUCTOR DEVICE, Diode	41416	14433 ITT244
CR2 through CR4	Same as CR1		
CR5	SEMICONDUCTOR DEVICE, Diode (Selected)	41075-0001 41075-0002 41075-0003 41075-0004 41075-0005	
CR6 through CR10	Same as CR5		
C1	CAPACITOR, Fixed, ceramic disk, 0.0022 uF ± 20 percent, 500 Vdc	37983-9224	56289 C023
C2	CAPACITOR, Fixed, ceramic, .01 uF ± 10 percent, 200 Vdc	28448-0103	15450 Type X5F
C3	CAPACITOR, Fixed, tantalum, 1.0 uF ± 20 percent, 35 Vdc	40248-2074	56289 196D105X-0035HA1
C4	Same as C3		
C5	CAPACITOR, Fixed, mylar, 0.01 uF ± 10 percent, 80 Vdc	32423-9103	56289 192P
C6	Same as C5		
C7	CAPACITOR, Fixed, ceramic, 0.01 uF ± 20 %, 18 Vdc	41915-0103	15450 5700
C8	CAPACITOR, Fixed, mylar, 0.047 uf ± 10 percent, 80 Vdc	32423-9473	56289 Type 196D
C9	CAPACITOR, Fixed, tantalum, 4.7 uF ± 20 percent, 10 Vdc	40248-2106	56289 196D475X-0010MA3
C10	CAPACITOR, Fixed, mica, 43 pF ± 10 percent, 50 Vdc	37967-0430	72136
C11	CAPACITOR, Fixed, mica, (Selected) ± 10 percent, 50 Vdc	37967-XXXX	72136
C12	CAPACITOR, Variable, ceramic rotary, 4.5 to 20 pF, min +10, max -10 +70 percent, 160 Vdc	34676-0004	28965 7S-TRIKO 02 4.5/ 20 pF N750
C13	Same as C3		
C14	CAPACITOR, Fixed, ceramic, 0.1 uF ± 20 percent, 18 Vdc	41915-0104	15450 5700
C15	Same as C14		
C16	Same as C3		

Reference Designation	Description	Part No.	Manufacturer And Part No.
	R.F. MODULE A2 (Cont)		
C17	Same as C3		
C18	Same as C12		
C19	Same as C11		
C20	Same as C14		
C21	Same as C3		
C22	Same as C12		
C23	Same as C11		
C24	Same as C14		
C25	Same as C3		
C26	Same as C5		
C27	Same as C5		
C28	Same as C14		
C29	Same as C3		
C30	CAPACITOR, Fixed, tantalum, 68 uF ± 20 percent, 15 Vdc	40248-2173	56289 196D686X-0015LA3
C31	Same as C11		
C32	Same as C12		
C33	Same as C11		
C34	Same as C12		
C35	Same as C11		
C36	Same as C12		
C37	Same as C14		
C38	Same as C3		
C39	Same as C14		
C40	Same as C3		
C41	Same as C3		
C42	CAPACITOR, Fixed, titanium ceramic, 4.7 uuF ± 5 percent, 500 Vdc	8879-9471	78488 TYPE GA
C43	Same as C3		
C44	Same as C5		

Reference Designation	Description	Part No.	Manufacturer And Part No.
	R.F. MODULE A2 (Cont)		
C45	Same as C12		
C46	Same as C11		
C47	Same as C12		
C48	Same as C11		
C49	Same as C12		
C50	Same as C11		
C51	Same as C9		
C52	Same as C14		
C53	Same as C3		
C54	Same as C14		
C55	Same as C3		
C56	CAPACITOR, Fixed, mylar, 0.022 uF ± 10 percent, 80 Vdc	32423-9223	56289 192P
C57	Same as C7		
L1	INDUCTOR, R.F., shielded, 3,300 uH ± 10 percent	34614-1332	
L2	INDUCTOR, R.F., shielded, 68,000 uH ± 10 percent	34614-1683	
L3	INDUCTOR, R.F., shielded, 1,200 uH ± 10 percent	34614-1122	
L4	INDUCTOR, R.F., shielded, 220 uH ± 10 percent	34614-1221	
L5	INDUCTOR, Variable, 500 uH nominal	41033-0001	54753 EX22630
L6	INDUCTOR, Variable, 98 uH nominal	41033-0002	54753 EX22631
L7	Same as L6		
L8	INDUCTOR, Variable, 290 uH nominal	41033-0004	54753 EX22633
L9	INDUCTOR, Variable, 1080 uH nominal	41033-0003	54753 EX22632
L10	INDUCTOR, R.F., shielded 1000 uH ± 10 percent	34614-1102	
Q1	TRANSISTOR, Silicon, NPN	36961-4124	04713 2N4124

Reference Designation	Description	Part No.	Manufacturer And Part No.
	R.F. MODULE A2 (Cont)		
Q2	Same as Q1		
Q3	TRANSISTOR, Silicon, PNP	36962-4126	04713 2N4126
Q4	Same as Q3		
Q5 through Q7	Same as Q1		
Q8	TRANSISTOR, MOS FET	41123-0002	86684 40822
Q9 through Q12	Same as Q1		
Q13	Same as Q8		
R1	RESISTOR, Fixed, composition, 330 ohms ± 10 percent, 1/4 watt	200-0331	01121 CB3311
R2	RESISTOR, Fixed, composition, 330, 000 ohms ± 10 percent, 1/4 watt	200-0334	01121 CB3341
R3	Same as R1		
R4	Same as R2		
R5	RESISTOR, Fixed, composition, .22, 000 ohms ± 10 percent, 1/4 watt	200-0223	01121 CB2231
R6 through R10	Same as R5		
R11	RESISTOR, Fixed, composition, 2, 700 ohms ± 10 percent, 1/4 watt	200-0272	01121 CB2721
R12	RESISTOR, Variable, 100 ohms ± 20 percent, 1/2 watt	40878-1101	80294 3359W
R13	RESISTOR, Fixed, composition, 3, 900 ohms ± 10 percent, 1/4 watt	200-0392	01121 CB3921
R14	RESISTOR, Fixed, composition, 1, 800 ohms ± 10 percent, 1/4 watt	200-0182	01121 CB1821
R15	RESISTOR, Fixed, composition, 220, 000 ohms ± 10 percent, 1/4 watt	200-0224	01121 CB2241
R16	Same as R1		
R17	RESISTOR, Fixed, composition, 100, 000 ohms ± 10 percent, 1/4 watt	200-0104	01121 CB1041

Reference Designation	Description	Part No.	Manufacturer And Part No.
	R. F. MODULE A2 (Cont)		
R18	Same as R17		
R19	RESISTOR, Fixed, composition, 1, 000 ohms ± 10 percent, 1/4 watt	200-0102	01121 CB1021
R20	Same as R19		
R21	Same as R2		
R22	Same as R15		
R23	Same as R2		
R24	RESISTOR, Fixed, composition, 100 ohms ± 10 percent, 1/4 watt	200-0101	01121 CB1011
R25	RESISTOR, Fixed, composition, 220 ohms ± 10 percent, 1/4 watt	200-0221	01121 CB2211
R26	Same as R1		
R27	Same as R2		
R28	Same as R2		
R29	Same as R1		
R30	RESISTOR, Fixed, composition, 120, 000 ohms ± 10 percent, 1/4 watt	200-0124	01121 CB1241
R31	Same as R30		
R32	Same as R2		
R33	RESISTOR, Fixed, composition, 2, 200 ohms ± 10 percent, 1/4 watt	200-0222	01121 CB2221
R34	RESISTOR, Fixed, composition, 1, 100 ± 10 percent, 1/4 watt	200-0112	01121 CB1121
R35	Same as R1		
R36	Same as R2		
R37	Same as R2		
R38	RESISTOR, Fixed, composition, 270 ohms ± 10 percent, 1/4 watt	200-0271	01121 CB2711
R39	RESISTOR, Fixed, composition, 5, 600 ohms ± 10 percent, 1/4 watt	200-0562	01121 CB5621
R40	Same as R1		

Reference Designation	Description	Part No.	Manufacturer And Part No.
	R.F. MODULE A2 (Cont)		
R41	RESISTOR, Fixed, composition, 680 ohms ± 10 percent, 1/4 watt	200-0681	01121 CB6811
T1	TRANSFORMER, RF, Antenna	41118	54753 EX22611
T2	TRANSFORMER, RF	41119-0001	54753 EX22902
T3	TRANSFORMER, RF	41119-0002	54753 EX22589
T4	TRANSFORMER, RF	41119-0003	54753 EX22590

Reference Designation	Description	Part No.	Manufacturer And Part No.
	IF MODULE A3 (Part No. 41148-0000)		
CR1	SEMICONDUCTOR DEVICE, Rectifier, crystal	19663	11413 1N90
CR2	Same as CR1		
CR3	Same as CR1		
C1	CAPACITOR, Fixed, ceramic 3,300 pF ± 20 percent, 200 Vdc	30954-0332	15450
C2	CAPACITOR, Fixed, tantalum, 10 uF ± 20 percent, 20 Vdc	40248-2211	56289 196D106X-0020JA1
C3	CAPACITOR, Fixed, tantalum, 1 uF ± 20 percent, 35 Vdc	40248-2074	56289 196D105X-0035HA1
C4	Same as C1		
C5	CAPACITOR, Fixed, mylar, 0.22 uF ± 20 percent, 50 Vdc	39989-9222	84411 TYPE601PE
C6	CAPACITOR, Fixed, tantalum, 33 uF ± 20 percent, 25 Vdc	40248-2518	56289 196D336X-0025LA3
C7	CAPACITOR, Fixed, mica, 470 pF ± 5 percent, 500 Vdc	30429-0471	
C8	CAPACITOR, Fixed, ceramic 150 pF ± 10 percent, 200 Vdc	28448-0151	15450 TYPE GP4
C9	CAPACITOR, Fixed, tantalum, 4.7 uF ± 20 percent, 35 Vdc	40248-2366	56289 196D475X-0035JA1
C10	CAPACITOR, Fixed, ceramic 4,700 pF ± 10 percent, 200 Vdc	30949-0472	15450
C11	NOT USED		
C12	CAPACITOR, Fixed, ceramic, 0.1 uF +80, -20 percent, 25 Vdc	31456-9102	15450
C13	CAPACITOR, Fixed, ceramic, 3,300 pF ± 10 percent, 200 Vdc	30954-0332	15450
C14	CAPACITOR, Fixed, ceramic, 2,200 pF ± 10 percent, 200 Vdc	30949-0222	15450
C15	Same as C12		
C16	CAPACITOR, Fixed, tantalum, 2.2 uF ± 20 percent, 20 Vdc	40248-2203	56289 196D225X-0020HA1
C17	Same as C14		
C18	CAPACITOR, Fixed, mylar, 0.33 uF ± 20 percent, 50 Vdc	39989-9332	84411 TYPE601PE

Reference Designation	Description	Part No.	Manufacturer And Part No.	
IF MODULE A3 (Cont)				
C19	Same as C3			
C20	Same as C16			
C21	Same as C14			
C22	Same as C14			
C23	CAPACITOR, Fixed, plastic, 0.047 uF ± 10 percent, 250 Vdc	36054-1473	73445	C280AE
C24	CAPACITOR, Fixed, tantalum, 68 uF ± 20 percent, 15 Vdc	40248-2173	56289	196D686X-0015LA3
C25	Same as C12			
C26	CAPACITOR, Fixed, tantalum, 150 uF ± 20 percent, 15 Vdc	40248-2177	56289	196D157X-0015MA3
C27	NOT USED			
C28	CAPACITOR, Fixed, tantalum, 22 uF ± 20 percent, 15 Vdc	40248-2166	56289	196D226X-0015KA1
C29	Same as C2			
C30	Same as C12			
C31	NOT USED			
C32	NOT USED			
C33	Same as C2			
C34	Same as C16			
C35	Same as C12			
C100	CAPACITOR, Fixed, mica, 100 pF ± 10 percent	37967-0101	72136	
C101	Same as C13			
C102	Same as C3			
C103	Same as C100			
C104	Same as C3			
C105	CAPACITOR, Fixed, ceramic, 1,500 pF ± 10 percent, 200 Vdc	30949-0152	15450	
FL1	FILTER, Bandpass, 141.0 kHz	41160	54753	EX22938
L1	INDUCTOR, R.F., Shielded, 4,700 uH ± 5 percent	34614-0472		

Reference Designation	Description	Part No.	Manufacturer And Part No.
	IF MODULE A3 (Cont)		
L2	INDUCTOR, R.F., Shielded, 1,000 uH ± 5 percent	34614-0102	
L3	Same as L2		
L100	INDUCTOR, R.F., Shielded 3,900 uH ± 5 percent	34614-0392	
Q1	TRANSISTOR, Silicon, MOS FET	39409	86684 40673
Q2	TRANSISTOR, Silicon, NPN	36961-4124	04713 2N4124
Q3	Same as Q2		
Q4	Same as Q2		
Q100	TRANSISTOR, Silicon, PNP	36962-4126	04713 2N4126
R1	RESISTOR, Fixed, composition 47,000 ohms ± 10 percent, 1/4 watt	200-0473	01121 CB4731
R2	RESISTOR, Fixed, composition 330,000 ohms ± 10 percent, 1/4 watt	200-0334	01121 CB3341
R3	RESISTOR, Fixed, composition, 220 ohms ± 10 percent, 1/4 watt	200-0221	01121 CB2211
R4	RESISTOR, Fixed, composition, 100 ohms ± 10 percent, 1/4 watt	200-0101	01121 CB1011
R5	RESISTOR, Fixed, composition, 22,000 ohms ± 10 percent, 1/4 watt	200-0223	01121 CB2231
R6	NOT USED		
R7	RESISTOR, Fixed, composition, 4,700 ohms ± 10 percent, 1/4 watt	200-0472	01121 CB4721
R8	RESISTOR, Fixed, composition, 680 ohms ± 10 percent, 1/4 watt	200-0681	01121 CB6811
R9	RESISTOR, Fixed, composition, 22 ohms ± 10 percent, 1/4 watt	200-0220	01121 CB2201
R10 through R13	NOT USED		
R14	RESISTOR, Fixed, composition, 82,000 ohms ± 10 percent, 1/4 watt	200-0823	01121 CB8231
R15	RESISTOR, Variable, 47,000 ohms ± 20 percent, 1/2 watt	40878-1473	80294 3359W
R16	NOT USED		

Reference Designation	Description	Part No.	Manufacturer And Part No.
	IF MODULE A3 (Cont)		
R17	RESISTOR, Fixed, composition, 100,000 ohms ± 10 percent, 1/4 watt	200-0104	01121 CB1041
R18	RESISTOR, Fixed, composition, 39,000 ohms ± 10 percent, 1/4 watt	200-0393	01121 CB3931
R19	RESISTOR, Fixed, composition, 1,000 ohms ± 10 percent, 1/4 watt	200-0102	01121 CB1021
R20	RESISTOR, Fixed, composition, 2,200 ohms ± 10 percent, 1/4 watt	200-0222	01121 CB2221
R21	RESISTOR, Fixed, composition, 470,000 ohms ± 10 percent, 1/4 watt	200-0474	01121 CB4741
R22	RESISTOR, Fixed, composition, 3.3 ohms ± 5 percent, 1/2 watt	201-9331	01121 EB9331
R23	RESISTOR, Fixed, composition, 10 ohms ± 10 percent, 1/4 watt	200-0100	01121 CB1001
R24	RESISTOR, Fixed, composition, 56,000 ohms ± 10 percent, 1/4 watt	200-0563	01121 CB5631
R25	RESISTOR, Fixed, composition, 33,000 ohms ± 10 percent, 1/4 watt	200-0333	01121 CB3331
R26	RESISTOR, Fixed, composition, 3,300 ohms ± 10 percent, 1/4 watt	200-0332	01121 CB3321
R27	RESISTOR, Fixed, composition, 270 ohms ± 10 percent, 1/4 watt	200-0271	01121 CB2711
R28	Same as R15		
R29	RESISTOR, Fixed. composition, 15 ohms ± 10 percent, 1/4 watt	200-0150	01121 CB1501
R30	Same as R7		
R31	RESISTOR, Fixed, composition, 470 ohms ± 10 percent, 1/4 watt	200-0471	01121 CB4711
R32	Same as R2		
R33	Same as R25		
R34	NOT USED		
R35	NOT USED		
R36	Same as R15		
R37	Same as R17		
R38	Same as R4		

Reference Designation	Description	Part No.	Manufacturer And Part No.
	IF MODULE A3 (Cont)		
R39	Same as R7		
R40	Same as R2		
R41	RESISTOR, Fixed, composition, 33 ohms ± 10 percent, 1/4 watt	200-0330	01121 CB3301
R42	RESISTOR, Fixed, composition (insulated) 43,000 ohms ± 10 percent, 1/4 watt	341-0433	01121 CB4335
R43	Same as R5		
R100	RESISTOR, Fixed, composition, 8,200 ohms ± 10 percent, 1/4 watt	200-0822	01121 CB8221
R101	RESISTOR, Fixed, composition, 2,200 ohms ± 10 percent, 1/4 watt	200-0222	01121 CB1821
R102	RESISTOR, Fixed, composition, 1,800 ohms ± 10 percent, 1/4 watt	200-0182	01121 CB1821
T1	TRANSFORMER, IF	41088	54753 EX22906
T2	TRANSFORMER, AUDIO	34765	97622 GK3379
U1	INTEGRATED CIRCUIT, Audio amplifier	38265-0000	86684 CA3020
U2	Same as U1		
W100	CABLE, R.F.	18327	
Y100	CRYSTAL, Quartz, frequency 142.000 kHz	41044	

Reference Designation	Description	Part No.	Manufacturer And Part No.
SERVO MODULE A4 (Part No. 41146-0000)			
CR1	SEMICONDUCTOR DEVICE, Diode	32689-0005	01295 1N458
CR2	Same as CR1		
CR3	SEMICONDUCTOR DEVICE, Rectifier, silicon	33831-0201	13327 FSCER69-5
CR4	SEMICONDUCTOR DEVICE, Diode, zener	35954-9561	04713 1N4734A
C1	CAPACITOR, Fixed, tantalum, 15 uF ± 10 percent, 20 Vdc	40248-1213	56289 196D156X-9020KA1
C2	CAPACITOR, Fixed, tantalum, 1.0 uF ± 20 percent, 35 Vdc	40248-2074	56289 196D105X-0035HA1
C3	Same as C2		
C4	Same as C1		
C5	NOT USED		
C6	NOT USED		
C7	CAPACITOR, Fixed, mylar 0.15 uF ± 10 percent, 80 Vdc	32423-9333	
C8	Same as C7		
C9	CAPACITOR, Fixed, mylar, 0.15 uF ± 10 percent, 100 Vdc maximum at 85°C	32423-9152	
C10	Same as C7		
C11	Same as C7		
C12	CAPACITOR, Fixed, tantalum, 4.7 uF ± 20 percent, 35 Vdc	40248-2366	56289 196D475X-0035JA1
C13	Same as C12		
C14	CAPACITOR, Fixed, electrolytic, 150 uF + 100, -10 percent, 63 Vdc	38268-6402	73445 ET151X-063A01
C15	CAPACITOR, Fixed, tantalum, 47 uF ± 20 percent, 25 Vdc	40248-2520	56289 196D476X-0025MA3
C16	CAPACITOR, Fixed, mylar, 0.01 uF ± 10 percent, 80 Vdc	32423-9103	
C17	Same as C12		
C18	CAPACITOR, Fixed, electrolytic, 100 uF + 100, - 10 percent, 16 Vdc	38269-1606	73445 ET101X-016A5

Reference Designation	Description	Part No.	Manufacturer And Part No.	
	SERVO MODULE A4 (Cont)			
C19	Same as C18			
F1	FUSE, Instrument, 3 amperes	36968-3000	75915	275002
Q1	TRANSISTOR, Silicon, NPN	34619	86684	2N3053
Q2	Same as Q1			
Q3	AMPLIFIER, Darlington	39269-5305	03508	2N5305
Q4	Same as Q3			
Q5	Same as Q1			
Q6	Same as Q1			
Q7	Same as Q1			
Q8	TRANSISTOR, Silicon, NPN	36961-4124	04713	2N4124
R1	RESISTOR, Fixed, composition, 27,000 ohms ± 10 percent, 1/4 watt	200-0273	01121	CB2731
R2	Same as R1			
R3	RESISTOR, Fixed, composition, 27 ohms ± 10 percent, 1/4 watt	200-0270	01121	CB2701
R4	Same as R3			
R5	NOT USED			
R6	NOT USED			
R7	RESISTOR, Variable, 2000 ohms ± 20 percent, 1/2 watt	40878-1222	80294	3359W
R8	RESISTOR, Fixed, composition, 120,000 ohms ± 10 percent, 1/4 watt	200-0124	01121	CB1241
R9	RESISTOR, Variable, 5000 ohms ± 20 percent, 1/2 watt	40878-1472	80294	3359W
R10	RESISTOR, Fixed, composition, 270,000 ohms ± 10 percent, 1/4 watt	200-0274	01121	CB2741
R11	RESISTOR, Fixed, composition, 2,200 ohms ± 10 percent, 1/4 watt	200-0222	01121	CB2221
R12	RESISTOR, Fixed, composition, 1,200 ohms ± 10 percent, 1/4 watt	200-0122	01121	CB1221
R13	RESISTOR, Fixed, composition, 3,900 ohms ± 10 percent, 1/4 watt	200-0392	01121	CB3921
R14	Same as R8			
R15	Same as R9			

Reference Designation	Description	Part No.	Manufacturer And Part No.
	SERVO MODULE A4 (Cont)		
R16	Same as R10		
R17	RESISTOR, Fixed, composition, 1,000 ohms ± 10 percent, 1/4 watt	200-0102	01121 CB1021
R18	Same as R13		
R19	RESISTOR, Fixed, composition, 470 ohms ± 10 percent, 1/4 watt	200-0471	01121 CB4711
R20	RESISTOR, Fixed, composition, 22 ohms ± 10 percent, 1/4 watt	200-0220	01121 CB2201
R21	RESISTOR, Fixed, composition, 560,000 ohms ± 10 percent, 1/4 watt	200-0564	01121 CB5641
R22	Same as R21		
R23	RESISTOR, Fixed, composition, 150 ohms ± 10 percent, 1/4 watt	200-0151	01121 CB1511
R24	Same as R23		
R25	RESISTOR, Fixed, composition, 68 ohms ± 5 percent, 1/2 watt	201-0680	01121 EB6801
R26	Same as R12		
R27	Same as R7		
R28	Same as R11		
R29	RESISTOR, Fixed, composition, 680 ohms ± 10 percent, 1/4 watt	200-0681	01121 CB6811

Reference Designation	Description	Part No.	Manufacturer And Part No.
PHASE DETECTOR MODULE A5 (Part No. 41152-0000)			
C1	CAPACITOR, Fixed, tantalum, 68 uF ± 20 percent, 15 Vdc	40248-2173	56289 196D686X-0015LA3
C2	CAPACITOR, Fixed, mylar, 0.022 uF ± 10 percent, 100 Vdc	32423-9223	56289 192P
C3	CAPACITOR, Fixed, ceramic, 4,700 pF ± 20 percent, 200 Vdc	30954-0472	15450
C4	CAPACITOR, Fixed, mylar, 0.022 uF ± 10 percent, 100 Vdc maximum at 85°C	32423-9223	56289 192P
C5	CAPACITOR, Fixed, ceramic, 0.01 uF ± 10 percent, 100 Vdc	32423-9103	56289 192P
C6	NOT USED		
C7	CAPACITOR, Fixed, tantalum, 4.7 uF ± 20 percent, 10 Vdc	40248-2106	56289 196D475X-0010MA3
C8	CAPACITOR, Fixed, mylar, 0.1 uF ± 10 percent, 100 Vdc	32423-9102	56289 192P
C9	Same as C5		
C10	CAPACITOR, Fixed, tantalum, 10 uF ± 20 percent, 35 Vdc	40248-2371	56289 196D106X-0035LA3
C11	CAPACITOR, Fixed, tantalum, 33 uF ± 20 percent, 10 Vdc	40248-2116	56289 196D336X-0010KA1
C12	CAPACITOR, Fixed, ceramic, 220 uF ± 10 percent, 200 Vdc	30949-0221	15450
C13	CAPACITOR, Fixed, tantalum, 6.8 uF ± 20 percent, 35 Vdc	40248-2368	56289 196D685X-0035KA1
C14	CAPACITOR, Fixed, tantalum, 100 uF ± 20 percent, 20 Vdc	40248-2224	56289 196D107X-0020MA3
C15	CAPACITOR, Fixed, tantalum, 1.0 uF ± 20 percent, 35 Vdc	40248-2074	56289- 196D105X-0035HA1
C16	CAPACITOR, Fixed, ceramic, 0.1 uF ± 20 percent, 18 Vdc	41915-0104	15450 5700
C17	Same as C16		
C18	Same as C16		
C19	Same as C16		
CR1	SEMICONDUCTOR DEVICE, Diode	32689-0005	01295 1N458

Reference Designation	Description	Part No.	Manufacturer And Part No.
PHASE DETECTOR MODULE A5 (Cont)			
CR2	SEMICONDUCTOR DEVICE, Diode	34410	93332 1N270
CR3 through CR6	Same as CR1		
L1	INDUCTOR, R.F., shielded, 4,700 uH ± 20 percent	34614-2472	
Q1	TRANSISTOR, Silicon, PNP	36962-4126	04713 2N4126
Q2	Same as Q1		
Q3	TRANSISTOR, Silicon, NPN	36961-4124	04713 2N4124
Q4	Same as Q3		
Q5	Same as Q3		
Q6	TRANSISTOR, Silicon, FET	38779	04713 2N4352
Q7	TRANSISTOR, J FET	41123-0001	01295 2N3821
Q8	Same as Q1		
Q9	Same as Q3		
Q10	Same as Q1		
RT1	RESISTOR, Thermal, coated, radial leads, 500 ohms ± 10 percent at + 25°C, 6.0 mV/°C	40651	
R1	RESISTOR, Fixed, composition, 3,300 ohms ± 10 percent, 1/4 watt	200-0332	01121 CB3321
R2	RESISTOR, Fixed, composition, 15,000 ohms ± 10 percent, 1/4 watt	200-0153	01121 CB1531
R3	RESISTOR, Fixed, composition, 10,000 ± 10 percent, 1/4 watt	200-0103	01121 CB1031
R4	RESISTOR, Variable, 10,000 ohms ± 20 percent, 1/2 watt	40878-1103	80294 3359W
R5	RESISTOR, Fixed, composition, 1,000 ohms ± 10 percent, 1/4 watt	200-0102	01121 CB1021
R6	Same as R2		
R7 through R10	Same as R1		
R11	Same as R5		
R12	Same as R3		

Reference Designation	Description	Part No.	Manufacturer And Part No.
	PHASE DETECTOR MODULE A5 (Cont)		
R13	RESISTOR, Fixed, composition, 560 ohms ± 10 percent, 1/4 watt	200-0561	01121 CB5611
R14	RESISTOR, Fixed, composition, 27 ohms ± 10 percent, 1/4 watt	200-0270	01121 CB2701
R15	Same as R5		
R16	RESISTOR, Fixed, composition, 4,700 ohms ± 10 percent, 1/4 watt	200-0472	01121 CB4721
R17	NOT USED		
R18	RESISTOR, Fixed, composition, 2,700 ohms ± 10 percent, 1/4 watt	200-0272	01121 CB2721
R19	RESISTOR, Fixed, composition, 22,000 ohms ± 10 percent, 1/4 watt	200-0223	01121 CB2231
R20	NOT USED		
R21	NOT USED		
R22	NOT USED		
R23	RESISTOR, Fixed, composition, 1,800 ohms ± 10 percent, 1/4 watt	200-0182	01121 CB1821
R24	RESISTOR, Fixed, composition, 120 ohms ± 10 percent, 1/4 watt	200-0121	01121 CB1211
R25	RESISTOR, Fixed, composition, 1,200 ohms ± 10 percent, 1/4 watt	200-0122	01121 CB1221
R26	Same as R5		
R27	Same as R5		
R28	Same as R1		
R29 through R31	Same as R5		
R32	RESISTOR, Fixed, composition, 12,000 ohms ± 10 percent, 1/4 watt	200-0123	01121 CB1231
R33	NOT USED		
R34	NOT USED		
R35	RESISTOR, Fixed, composition, 68,000 ohms ± 10 percent, 1/4 watt	200-0683	01121 CB6831
R36	RESISTOR, Variable, 2,200 ohms ± 20 percent, 1/2 watt	40878-1222	80294 3359W
R37	NOT USED		
R38	RESISTOR, Fixed, wire-wound, 15 ohms ± 5 percent, 5 watts	36604-0150	44655 995-5B

Reference Designation	Description	Part No.	Manufacturer And Part No.
	PHASE DETECTOR MODULE A5 (Cont)		
R39	NOT USED		
R40	RESISTOR, Fixed, composition, 8,200 ohms ± 10 percent, 1/4 watt	200-0822	01121 CB8221
R41 through R43	Same as R40		
R44	RESISTOR, Fixed, composition (insulated) 51 ohms ± 5 percent, 1/4 watt	341-0510	01121 CB5105
R45	RESISTOR, Fixed, composition, 27 ohms ± 10 percent, 1/4 watt	200-0270	01121 CB2701
R46	RESISTOR, Fixed, composition, 120,000 ohms ± 10 percent, 1/4 watt	200-0124	01121 CB1241
R47	RESISTOR, Variable, 47,000 ohms ± 20 percent, 1/2 watt	40878-1473	80294 3359W
R48	NOT USED		
R49	RESISTOR, Fixed, composition, 330 ohms ± 5 percent, 1/4 watt	341-0331	01121 CB3315
R50	RESISTOR, Fixed, composition, 270 ohms ± 5 percent, 1/4 watt	341-0271	01121 CB2715
U1	NOT USED		
U2	INTEGRATED CIRCUIT, 4-bit binary counter	41066	01295 SN7493N
U3	INTEGRATED CIRCUIT, Flip-flop	36951	01295 SN7473N
U4	INTEGRATED CIRCUIT, Master-slave flip-flop	41067	01295 SN7472N
U5	INTEGRATED CIRCUIT, NAND gate	40145	01295 SN744ON
Y1	CRYSTAL, Quartz, frequency 128.000 kHz	41045	

Reference Designation	Description	Part No.	Manufacture And Part No.	
N DIVIDER MODULE A6 (Part No. 41154-0000)				
C1	CAPACITOR, Fixed, tantalum, 220 uF ± 2- percent, 10 Vdc	40248-2126	56289	196D227X-0010MA3
C2	CAPACITOR, Fixed, tantalum, 4.7 uF ± 20 percent, 10 Vdc	40248-2106	56289	196D475X-0010HA1
C3	CAPACITOR, Fixed, ceramic, 220 pF ± 10 percent , 200 Vdc	30949-0221	15450	
C4	CAPACITOR, Fixed, ceramic, 47 pF ± 5 percent, 200 Vdc	29597-0470		
C5	CAPACITOR, Fixed, ceramic, 1,000 pF ± 10 percent, 200 Vdc	30949-0102	15450	
C6	CAPACITOR, Fixed, ceramic, 100 pF ± 10 percent, 200 Vdc	28448-0101	15450	
C7 through C11	Same as C2			
CR1	SEMICONDUCTOR DEVICE, Diode	34410	93332	1N270
CR2	Same as CR1			
CR3	Same as CR1			
CR4	SEMICONDUCTOR DEVICE, Diode	32689-0005	01295	1N458
CR5	Same as CR4			
Q1	TRANSISTOR, Silicon, NPN	36961-4124	04713	2N4124
Q2 through Q4	Same as Q1			
R1	RESISTOR, Fixed, composition, 560 ohms ± 10 percent, 1/4 watt	200-0561	01121	CB5611
R2	RESISTOR, Fixed, composition, 330 ohms ± 10 percent, 1/4 watt	200-0331	01121	CB3311
R3	RESISTOR, Fixed, composition, 1,000 ohms ± 10 percent, 1/4 watt	200-0102	01121	CB1021
R4	RESISTOR, Fixed, composition, 100 ohms ± 10 percent, 1/4 watt	200-0101	01121	CB1011
R5	Same as R3			
R6	Same as R3			

Reference Designation	Description	Part No.	Manufacturer And Part	
N DIVIDER MODULE A6 (Cont)				
R7	Same as R2			
R8	Same as R1			
R9	Same as R4			
R10 through R27	Same as R3			
R28	RESISTOR, Fixed, composition, 27,000 ohms ± 10 percent, 1/4 watt	200-0273	01121	CB2731
R29	Same as R3			
R30	RESISTOR, Fixed, composition, 10,000 ohms, ± 10 percent, 1/4 watt	200-0103	01121	CB1031
R31	Same as R3			
R32	RESISTOR, Fixed, composition, 4,700 ohms ± 10 percent, 1/4 watt	200-0472	01121	CB4721
U1	INTEGRATED CIRCUIT, Hex inverter	41069	01295	SN7404N
U2	INTEGRATED CIRCUIT, Decade counter	41073	01295	SN7490N
U3	INTEGRATED CIRCUIT, Quad 2, input positive, NOR gate	41068	01295	SN7402N
U4	INTEGRATED CIRCUIT, NAND gate	40145	01295	SN7440N
U5	Same as U2			
U6	Same as U3			
U7	Same as U3			
U8	Same as U2			
U9	Same as U3			
U10	INTEGRATED CIRCUIT, 8-input NAND gate	36949	01295	SN7430N
U11	INTEGRATED CIRCUIT, Master-slave flip-flop	40147	01295	SN7476N
U12	Same as U3			
W1	CABLE, R.F.	18327		

Reference Designation	Description	Part No.	Manufacturer And Part No.	
VCO MODULE A7 (Part No. 41150)				
C1	CAPACITOR, Fixed, mica, (Selected) ± 10 percent, 50 Vdc	37967-XXXX	72136	
C2	Same as C1			
C3	Same as C1			
C4	CAPACITOR, Variable, ceramic rotary, 4.5 to 20 pF, min. + 10 percent, max. - 10 percent plus 70 percent, 160 Vdc	3476-0004	28965	7S-TR1KO-02-4.5/20pFN750
C5	Same as C4			
C6	Same as C4			
C7	CAPACITOR, Fixed, mylar 0.1 uF ± 10 percent, 80 Vdc	32423-9102	56289	192P
C8	Same as C7			
C9	CAPACITOR, Fixed, mica, 1,500 pF ± 2 percent, 500 Vdc	40632-2152	54753	SRDM19
C10	CAPACITOR, Fixed, mica, 910 pF ± 2 percent, 500 Vdc	40632-2911	54753	SRDM19
C11	Same as C10			
C12	CAPACITOR, Fixed, mica, 33 pF ± 5 percent, 100 Vdc	36245-0330	72136	
C13	Same as C7			
C14	NOT USED			
C15	CAPACITOR, Fixed, tantalum, 15 uF ± 20 percent, 20 Vdc	40248-2213	56289	196D156X-0020KA1
C16	CAPACITOR, Fixed, mica, 10 pF ± 10 percent, 50 Vdc	37967-9501	72136	
C17	CAPACITOR, Fixed, ceramic, 100 pF ± 10 percent, 200 Vdc	28448-0101	15450	
C18	CAPACITOR, Fixed, tantalum, 1.0 uF ± 20 percent, 35 Vdc	40248-2074	56289	196D105X-0035HA1
C19	Same as C18			
C20	Same as C18			
C21	CAPACITOR, Fixed, ceramic, 0.01 uF ± 20 percent, 18 Vdc	41915-0103	15450	

Reference Designation	Description	Part No.	Manufacturer And Part No.	
VCO MODULE A7 (Cont)				
C22 through C24	Same as C21			
C25	Same as C18			
C26	CAPACITOR, Fixed, tantalum, 4.7 uF ± 20 percent, 10 Vdc	40248-2106	56289	196D475X-0010HA1
C27 through C30	NOT USED			
C31	Same as C7			
CR1	SEMICONDUCTOR DEVICE, Diode (Selected)	41075-0001 41075-0002 41075-0003 41075-0004 41075-0005		
L1	INDUCTOR, Variable, 60 uH nominal	41033-0006	54753	EX22635
L2	INDUCTOR, Variable, 140 uH nominal	41033-0005	54753	EX22898
L3	INDUCTOR, Variable, 500 uH nominal		54753	EX22630
L4	INDUCTOR, R.F., Shielded, 1000 uH ± 5 percent	34614-0102		
Q1	TRANSISTOR, Silicon, NPN	36961-4124	04713	2N4124
Q2 through Q4	Same as Q1			
Q5	TRANSISTOR, Silicon, FET (Selected)	36269-0001	01295	SKA1455
Q6	TRANSISTOR, Silicon, PNP	36962-4126	04713	2N4126
R1	RESISTOR, Fixed, composition, 330,000 ohms ± 10 percent, 1/4 watt	200-0334	01121	CB3341
R2	Same as R1			
R3	RESISTOR, Fixed, composition, 100 ohms ± 10 percent, 1/4 watt	200-0101	01121	CB1011
R4	Same as R3			
R5	RESISTOR, Fixed, composition, 300 ohms ± 10 percent, 1/4 watt	200-0331	01121	CB3311
R6	Same as R5			
R7	Same as R1			
R8	Same as R1			

Reference Designation	Description	Part No.	Manufacturer And Part No.
	VCO MODULE A7 (Cont)		
R9	RESISTOR, Fixed, composition, 100, 000 ohms ± 10 percent, 1/4 watt	200-0104	01121 CB1041
R10	RESISTOR, Fixed, composition, 27, 000 ohms ± 10 percent, 1/4 watt	200-0273	01121 CB2731
R11	RESISTOR, Fixed, composition, 470 ohms ± 10 percent, 1/4 watt	200-0471	01121 CB4711
R12	RESISTOR, Fixed, composition, 47, 000 ohms ± 10 percent, 1/4 watt	200-0473	01121 CB4731
R13	RESISTOR, Fixed, composition, 4, 700 ohms ± 10 percent, 1/4 watt	200-0472	01121 CB4721
R14	NOT USED		
R15	RESISTOR, Fixed, composition, 680 ohms ± 10 percent, 1/4 watt	200-0681	01121 CB6811
R16	RESISTOR, Fixed, composition, 10, 000 ohms ± 10 percent, 1/4 watt	200-0103	01121 CB1031
R17	RESISTOR, Fixed, composition, 2, 200 ohms ± 10 percent, 1/4 watt	200-0222	01121 CB2221
R18	RESISTOR, Fixed, composition, (Selected) ± 10 percent, 1/4 watt	200-XXXX	01121
R19	RESISTOR, Fixed, composition, 82, 000 ohms ± 10 percent, 1/4 watt	200-0823	01121 CB8231
R20	RESISTOR, Fixed, composition, 560 ohms ± 10 percent, 1/4 watt	200-0561	01121 CB5611
R21	RESISTOR, Fixed, composition, 1, 000 ohms ± 10 percent, 1/4 watt	200-0102	01121 CB1021
R22	RESISTOR, Fixed, composition, 300 ohms ± 5 percent, 1/4 watt	341-0301	01121 CB3015
R23	RESISTOR, Fixed, composition, 56 ohms ± 10 percent, 1/4 watt	200-0560	01121 CB5601
R24	RESISTOR, Fixed, composition, 2, 200 ohms ± 10 percent, 1/4 watt	200-0222	01121 CB2221
R25	Same as R24		
R26	NOT USED		
R27	RESISTOR, Fixed, composition, 100, 000 ohms ± 10 percent, 1/4 watt	200-0104	01121 CB1041
U1	INTEGRATED CIRCUIT, Linear amplifier	40563	04713 MC1550G
U2	INTEGRATED CIRCUIT, Operational amplifier	38298	86684 CA3029

Reference Designation	Description	Part No.	Manufacturer And Part No.
	M-59B MOUNTING (Part No. 41350)		
J1	CONNECTOR, Receptacle, electrical (MS3102R16S-1P)	31169-0000	
J2	CONNECTOR, Receptacle, electrical (MS102R10SL-3P)	33871-1003	
J3	Same as J2		
J4	Same as J1		
J5	CONNECTOR, Receptacle, electrical	30718-0006	02660 94-55940

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-1 -	40950-1001	RECEIVER ASSEMBLY, ADF, R-346A (Light Shadow Grey Faceplate) . .	1	
-		RECEIVER ASSEMBLY, ADF, R-346A (Black Faceplate)	1	
-1	40952-1001	. PLATE, Identification	1	
-2	32399-0001	. KNOB	1	
		ATTACHING PARTS		
-3	302-0006	. SETSCREW, Fluted soc dr, cup pt, ... stl cad pl, No. 2-56NC-3A thd by 1/8 in. lg	2	
		---*---		
-4	26633-0011	. BEARING, Sleeve (96881 part no. . . . . 2L1-FF)	1	
-5	35422-000	. KNOB	1	
		ATTACHING PARTS		
-6	324-6012	. SETSCREW, Hexagon soc dr, cup . . . . . pt, stl, No. 6-32UNC-3A thd by 3/16 in. lg	2	
		---*---		
-7	35422-0001	. KNOB	1	
		ATTACHING PARTS		
-8	324-6012	. SETSCREW, Hexagon soc dr, cup . . . . . pt, stl, No. 6-32UNC-3A thd by 3/16 in. lg	1	
		---*---		
-9	40989	. KNOB	2	
		ATTACHING PARTS		
-10	324-6012	. SETSCREW, Hexagon soc dr, cup . . . . . pt, stl, No. 6-32UNC-3A thd by 3/16 in. lg	4	
		---*---		
-11	26633-0001	. BEARING, Sleeve (96881 part no. 4L1-FF)	2	
-12	40836-0002	. EMBLEM	1	
		ATTACHING PARTS		
-13	8040	. NUT, Hexagon, brs, ni pl, ... No. 4-40NC-2B thd	1	
-14	8497	. WASHER, Lock, int tooth, sst, No. 4 . . . . . (78189 part no. 1704)	2	
		---*---		
-15	41046-0001	. PANEL, Printed	1	
-16	41047	. PLATE	1	
		ATTACHING PARTS		
-17	102-0016	. SCREW, Machine, bind. hd, brs, ... ni pl, No. 2-56NC-2A thd by 1/4 in. lg	5	
-18	4421	. NUT, Hexagon, brs, ni pl, No. . . . . 2-56NC-2B thd	5	
-19	7001	. WASHER, Lock, int tooth, brz, ni pl, ... No. 2 (78189 part no. 1902)	5	
		---*---		
-20	41009-0001	. BEZEL	1	
		ATTACHING PARTS		
-21	144-0028	. SCREW, Machine, flat hd, brs, ni pl, ... No. 4-40NC-2A thd by 7/16 in. lg	4	
		---*---		
-22	41056	. COVER, Top	1	
		ATTACHING PARTS		
-23	194-0012	. SCREW, Machine, bind. hd, sst, No. 4-40NC-2A . . . . . thd by 3/16 in. lg	6	
		---*---		
-24	41057	. COVER, Bottom	1	
		ATTACHING PARTS		
-25	194-0012	. SCREW, Machine, bind. hd, sst, No. 4-40NC-2A . . . . . thd by 3/16 in. lg	6	
		---*---		
-26	41083	. SPACER	2	
		ATTACHING PARTS		
-27	194-0012	. SCREW, Machine, bind. hd, sst, No. 4-40NC-2A . . . . . thd by 3/16 in. lg	4	
		---*---		

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-1 -28	29609-0040	. SPACER	1	
		ATTACHING PARTS		
-29	104-0056	. SCREW, Machine, bind. hd, brs, ni pl, No. 4-40NC-2A by 7/8 in. lg	1	
-30	8497	. WASHER, Lock, int tooth, sst, No. 4 (78189 part no. 1704)	1	
		---*---		
-31	41144	. LOOP MODULE, A1	1	
-32	41156	. RF MODULE, A2	1	
-33	41148	. IF MODULE, A3	1	
-34	41146	. SERVO MODULE, A4	1	
-35	41152	. PHASE DETECTOR MODULE, A5	1	
-36	41154	. N DIVIDER MODULE, A6	1	
-37	41150	. VCO MODULE, A7	1	
-38	41117-0001	. CONTROL ASSEMBLY (See figure 6-2 for detail breakdown	1	
		ATTACHING PARTS		
-39	194-0012	. SCREW, Machine, bind. hd, sst, No. 4-40NC-2A thd by 3/16 in. lg	4	
		---*---		
-40	41125	. CHASSIS ASSEMBLY	1	
-41	35860-0126	. . CONNECTOR, Receptacle, electrical (81312 part no. MRAC26P)	1	
		ATTACHING PARTS		
-42	35862-0002	. . GUIDE, Pin, with nut and lockwasher, No. 4-40 thd, 55/64 in. lg	1	
-43	35862-0001	. . GUIDE, Socket, with nut and lockwasher, No. 4-40 thd, 25/32 in. lg	1	
-44	5838	. . TERMINAL, Formed	2	
		---*---		
-45	38513-5036	. . TRANSISTOR, Silicon, NPN (86684 part no. 2N5036)	1	
		ATTACHING PARTS		
-46	40468-0024	. . SCREW, Tapping, thread forming, stl, cad pl, No. 10-32 thd by 3/8 in. lg	2	
		---*---		
-47	39916	. . SOCKET, Transistor (97913 part no. LST1702-3)	1	
		ATTACHING PARTS		
-48	102-0016	. . SCREW, Machine, bind. hd, brs, ni pl, No. 2-56NC-2A thd by 1/4 in. lg	2	
-49	4421	. . NUT, Hexagon, brs, ni pl, No. 2-56NC-2B thd	2	
-50	7001	. . WASHER, Lock, int tooth, brz, ni pl, No. 2 (78189 part no. 1902)	2	
		---*---		
-51	38512	. . INSULATOR, Mica (08530 part no. RM1039)	1	
-52	41158	. . PRINTED WIRING ASSEMBLY, A8	1	
		ATTACHING PARTS		
-53	194-0012	. . SCREW, Machine, bind. hd, sst, No. 4-40NC-2A thd by 3/16 in. lg	8	
-54	19454-0003	. . STUD, Teflon	3	
		---*---		
-55	40733	. . PIN	2	
		ATTACHING PARTS		
-56	8040	. . NUT, Hexagon, brs, ni pl, No. 4-40NC-2B thd	2	
-57	8497	. . WASHER, Lock, int tooth, sst, No. 4 (78189 part no. 1704)	3	
-58	11884	. . SPACER	2	
		---*---		
-59	41051	. . BRACKET, End	1	
		ATTACHING PARTS		
-60	40468-4016	. . SCREW, Tapping, thread forming, stl, cad pl, No. 4-40 thd by 1/4 in. lg	4	
		---*---		

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-1 -61	31161-0001	. . FILTER, Radio interference . . . . . (56289 part no. 2JX47)	1	
-62	3873	. . TERMINAL, Brs, silver pl	1	
		ATTACHING PARTS		
-63	102-0012	. . SCREW, Machine, bind. hd, brs, ni pl, ... No. 2-56NC-2A thd by 3/16 in. lg	1	
-64	4421	. . NUT, Hexagon, brs, ni, pl, ... No. 2-56NC-2B thd	1	
-65	7001	. . WASHER, Lock, int tooth, brz, ni pl, ... No. 2 (78189 part no. 1902)	1	
		---*---		
-66	40779	. . NUT, Sheet spring (78553 part no. . . . . C13139-440-1)	24	
-67	41108	. . FRAME ASSEMBLY	1	

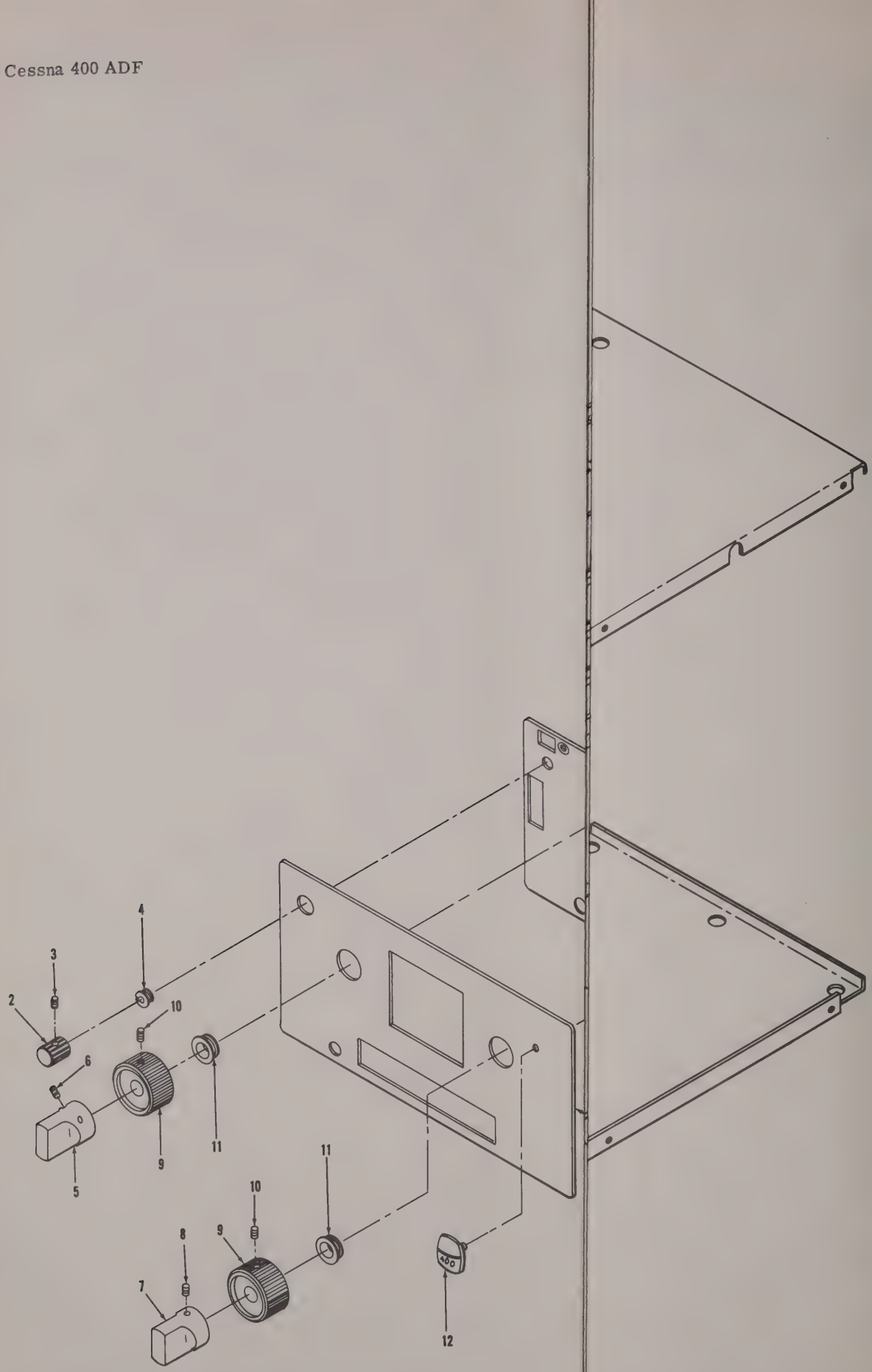


Figure 6-1. R-346A Receiver, Exploded View

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-2 -	41117-0001	CONTROL ASSEMBLY (See 38, figure 6-1 for NHA)	REF	
-1	29324	. PAWL	1	
		ATTACHING PARTS		
-2	168-0132	. SCREW, Machine, fil hd, brs, ni pl, No. 8-32NC-2A thd by 2-1/16 in. lg	1	
-3	28558-1008	. WASHER, Flat, CRES, No. 8 (AN960C8)	1	
		---*---		
-4	41062	. SWITCH, Pushbutton	1	
		ATTACHING PARTS		
-5	102-0016	. SCREW, Machine, bind. hd, brs, ni pl, No. 2-56NC-2A thd by 1/4 in. lg	2	
-6	13473	. WASHER, Spring	2	
		---*---		
-7	41086	. SHIELD	1	
-8	40974	. GEAR ASSEMBLY, Crown	2	
		ATTACHING PARTS		
-9	304-0006	. SETSCREW, Fluted soc dr, cup pt, stl, cad pl, No. 4-40NC-3A thd by 3/32 in. lg	4	
		---*---		
-10	41039	. RESISTOR, Variable, composition, 5000 ohms ±30 percent, 500 volts max (76055 Type MIC)	1	
		ATTACHING PARTS		
-11	COML	. NUT, Hexagon (Supplied with index 10)	1	
-12	8661	. WASHER, Lock, int tooth, sst, for 1/4 in. screw (78189 part no. 1714-05)	1	
		---*---		
-13	41036-0001	. WINDOW	1	
		ATTACHING PARTS		
-14	102-0016	. SCREW, Machine, bind. hd, brs, ni pl, No. 2-56NC-2A thd by 1/4 in. lg	4	
-15	13473	. WASHER, Spring	4	
		---*---		
-16	37226-0002	. FILTER, Lamp (22921 part no D152-100-9)	4	
-17	39847-0336	. LAMP, Incandescent, miniature (08806 part no. 336)	4	
-18	41079-0008	. LAMPHOLDER, Midget, grooved insulated (95263 part no. 25-08)	2	
		ATTACHING PARTS		
-19	40468-4016	. SCREW, Tapping, thread-forming, stl, cad pl, No. 4-40 thd by 1/4 in. lg	2	
-20	8543	. WASHER, Lock, split, brz, ni pl, No. 4	2	
		---*---		
-21	41079-0077	. LAMPHOLDER, Midget, grooved, insulated (95263 part no. 25-77R)	2	
		ATTACHING PARTS		
-22	40468-4016	. SCREW, Tapping, thread forming, stl, cad pl, No. 4-40 thd by 1/4 in. lg	2	
-23	8543	. WASHER, Lock, split, brz, ni pl, No. 4	2	
		---*---		
-24	40968	. GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-25	302-0008	. SETSCREW, Fluted soc dr, cup pt, stl, cad pl, No. 2-56NC-3A thd by 1/8 in. lg	2	
		---*---		
-26	40969	. GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-27	304-0012	. SETSCREW, Fluted soc dr, cup pt, stl, cad pl, No. 4-40NC-3A thd by 3/16 in. lg	1	
-28	304-0006	. SETSCREW, Fluted soc dr, cup pt, stl, cad pl, No. 4-40NC-3A thd by 3/32 in. lg	1	
		---*---		
-29	41078	. SWITCH, Rotary, dual	1	
		ATTACHING PARTS		
-30	COML	. NUT, Hexagon (supplied with index 25)	1	
-31	8540	. WASHER, Lock, int tooth, brz, ni pl (78189 part no. 1920-02)	1	

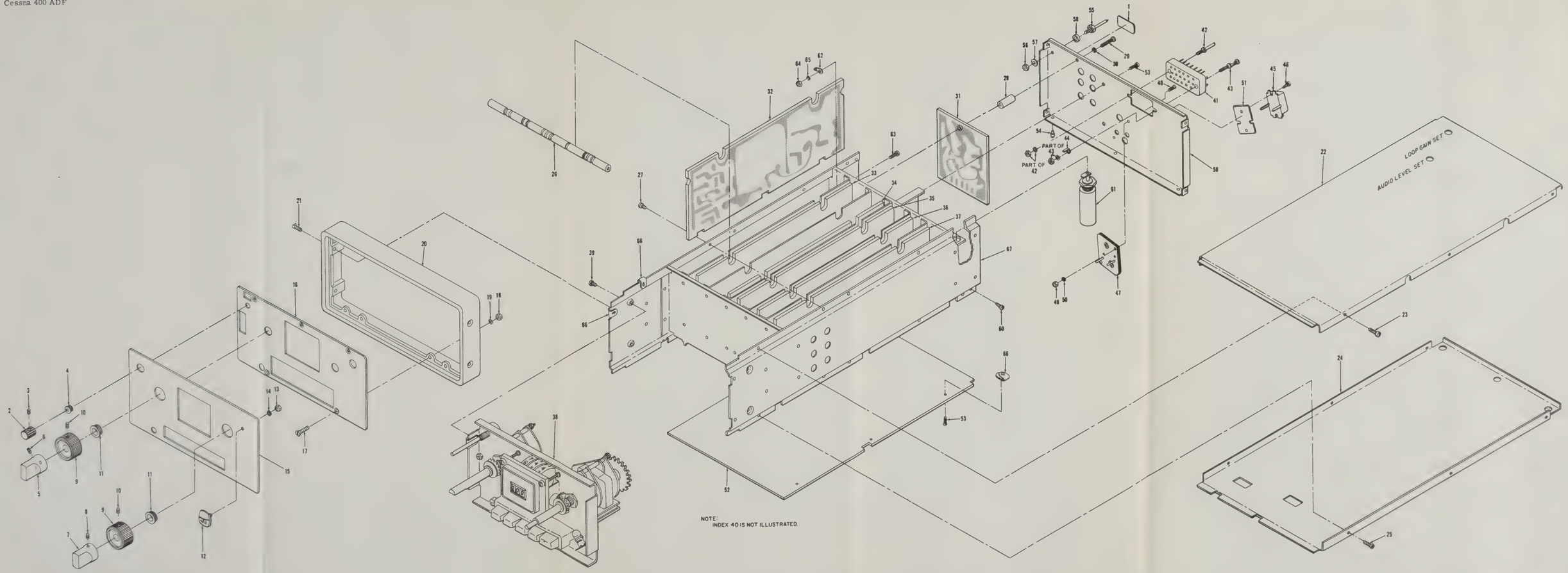
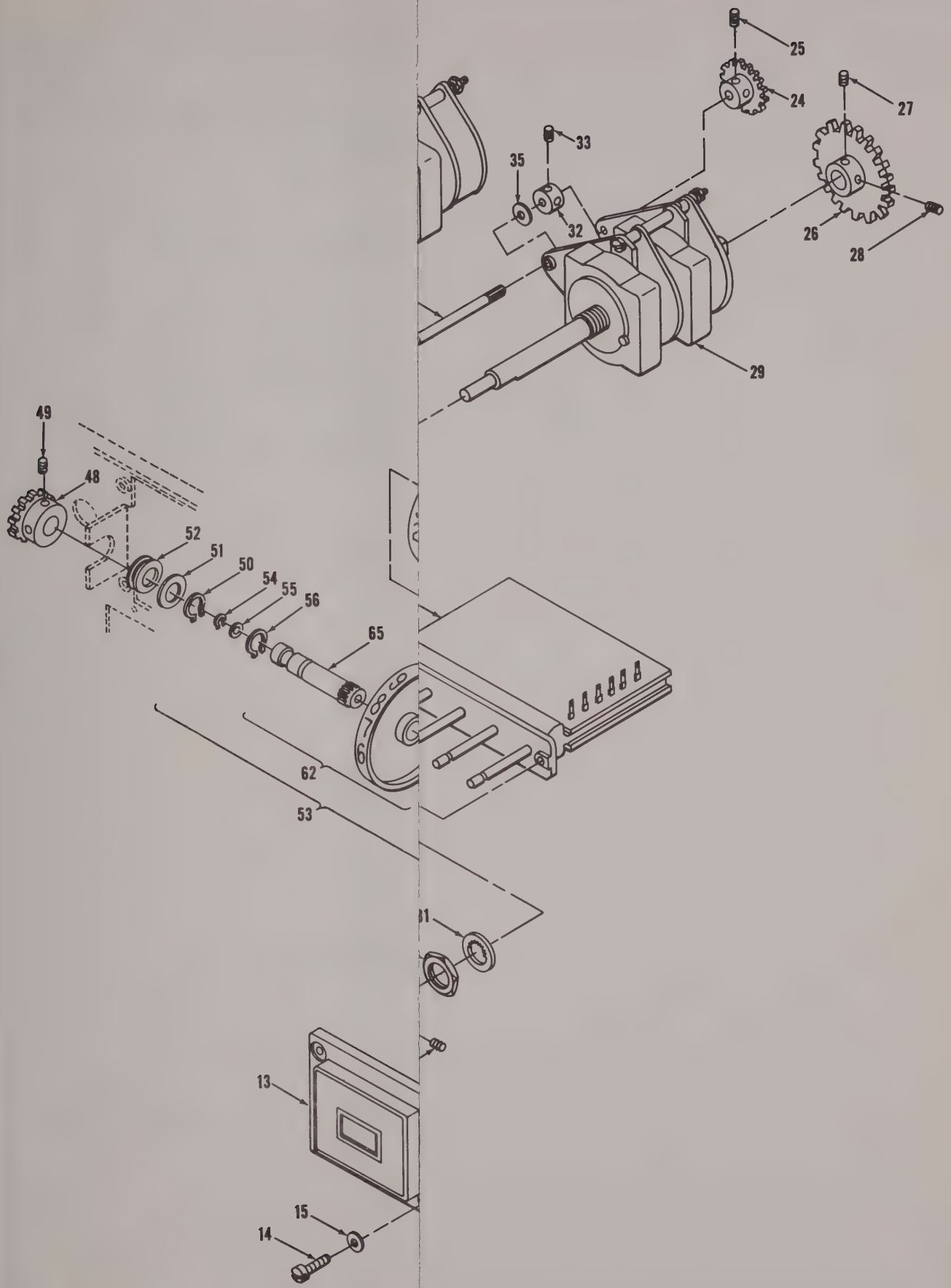


Figure 6-1. R-346A Receiver, Exploded View

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-2 -	41117-0001	CONTROL ASSEMBLY (See	REF	
		38, figure 6-1 for NHA)		
-1	29324	. PAWL	1	
		ATTACHING PARTS		
-2	168-0132	. SCREW, Machine, fil hd, brs, ni pl, ...	1	
		No. 8-32NC-2A thd by 2-1/16 in. lg		
-3	28558-1008	. WASHER, Flat, CRES, No. 8 (AN960C8)	1	
		---*---		
-4	41062	. SWITCH, Pushbutton	1	
		ATTACHING PARTS		
-5	102-0016	. SCREW, Machine, bind. hd, brs, ni pl, ...	2	
		No. 2-56NC-2A thd by 1/4 in. lg		
-6	13473	. WASHER, Spring	2	
		---*---		
-7	41086	. SHIELD	1	
-8	40974	. GEAR ASSEMBLY, Crown	2	
		ATTACHING PARTS		
-9	304-0006	. SETSCREW, Fluted soc dr, cup pt, stl, cad pl, ...	4	
		No. 4-40NC-3A thd by 3/32 in. lg		
		---*---		
-10	41039	. RESISTOR, Variable, composition, ...	1	
		5000 ohms ±30 percent, 500 volts max (76055 Type MIC)		
		ATTACHING PARTS		
-11	COML	. NUT, Hexagon (Supplied with	1	
		index 10)		
-12	8661	. WASHER, Lock, int tooth, sst, ...	1	
		for 1/4 in. screw (78189 part no. 1714-05)		
		---*---		
-13	41036-0001	. WINDOW	1	
		ATTACHING PARTS		
-14	102-0016	. SCREW, Machine, bind. hd, brs, ni pl, ...	4	
		No. 2-56NC-2A thd by 1/4 in. lg		
-15	13473	. WASHER, Spring	4	
		---*---		
-16	37226-0002	. FILTER, Lamp (22921 part no D152-100-9)	4	
-17	39847-0336	. LAMP, Incandescent, miniature	4	
		(08806 part no. 336)		
-18	41079-0008	. LAMPHOLDER, Midget, grooved insulated	2	
		(95263 part no. 25-08)		
		ATTACHING PARTS		
-19	40468-4016	. SCREW, Tapping, thread-forming, stl, cad pl, ...	2	
		No. 4-40 thd by 1/4 in. lg		
-20	8543	. WASHER, Lock, split, brz, ni pl, No. 4	2	
		---*---		
-21	41079-0077	. LAMPHOLDER, Midget, grooved, insulated	2	
		(95263 part no. 25-77R)		
		ATTACHING PARTS		
-22	40468-4016	. SCREW, Tapping, thread forming, stl, cad pl, ...	2	
		No. 4-40 thd by 1/4 in. lg		
-23	8543	. WASHER, Lock, split, brz, ni pl, No. 4	2	
		---*---		
-24	40968	. GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-25	302-0008	. SETSCREW, Fluted soc dr, cup pt, stl, cad pl, ...	2	
		No. 2-56NC-3A thd by 1/8 in. lg		
		---*---		
-26	40969	. GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-27	304-0012	. SETSCREW, Fluted soc dr, cup pt, stl, cad pl, ...	1	
		No. 4-40NC-3A thd by 3/16 in. lg		
-28	304-0006	. SETSCREW, Fluted soc dr, cup pt, stl, cad pl, ...	1	
		No. 4-40NC-3A thd by 3/32 in. lg		
		---*---		
-29	41078	. SWITCH, Rotary, dual	1	
		ATTACHING PARTS		
-30	COML	. NUT, Hexagon (supplied with index 25)	1	
-31	8540	. WASHER, Lock, int tooth, brz, ni pl	1	
		(78189 part no. 1920-02)		

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-2 -32	39463	. COLLAR, Shaft	1	
		ATTACHING PARTS		
-33	303-0008	. SETSCREW, Fluted soc dr, cup pt, stl, cad pl, No. 3-48NC-3A thd by 1/8 in. lg	2	
		---*---		
-34	28476-0012	. RING, Retaining, external, crescent	1	
-35	36516-0075	. WASHER, Flat, sst	1	
-36	40977	. GEAR, Spur	1	
		ATTACHING PARTS		
-37	302-0008	. SETSCREW, Fluted, soc dr, cup pt, stl, cad pl, No. 2-56NC-3A thd by 1/8 in. lg	2	
		---*---		
-38	41082	. SHAFT	1	
-39	41077-0001	. SWITCH, Rotary, single	1	
		ATTACHING PARTS		
-40	COML	. NUT, Hexagon (supplied with index 35)	1	
-41	8540	. WASHER, Lock, int tooth, brz, ni pl (78189 part no. 1920-02)	1	
		---*---		
-42	41115	. GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-43	304-0006	. SETSCREW, Fluted soc dr, cup pt, stl, cad pl, No. 4-40NC-3A thd by 3/32 in. lg	1	
		---*---		
-44	17768-0000	. SHIM, sst, 0.128 ID by 0.187 OD by 0.003 in. thk	AR	
-45	33138-0055	. BEARING, Flanged (12639 part no. 127-55)	1	
-46	40974	. GEAR ASSEMBLY, Crown	1	
		ATTACHING PARTS		
-47	304-0006	. SETSCREW, Fluted soc dr, cup pt, stl, cad pl, No. 4-40NC-3A thd by 3/32 in. lg	2	
		---*---		
-48	41116	. GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-49	304-0006	. SETSCREW, Fluted soc dr, cup pt, stl, cad pl, No. 4-40NC-3A thd by 3/32 in. lg	1	
		---*---		
-50	28665-0025	. RING, Retaining (MS16624-1025)	1	
-51	21623	. WASHER, Flat, sst	AR	
-52	33138-0115	. BEARING, Flanged (12639 part no. 127-115)	1	
-53	40943	. COUNTER ASSEMBLY	1	
-54	28476-0012	. . RING, Retaining, external, crescent	2	
-55	17768-0000	. . SHIM, sst, 0.128 ID by 0.187 OD by 0.003 in. thk	AR	
-56	28665-0025	. . RING, Retaining (MS16624-1025)	1	
-57	41085	. . WHEEL ASSEMBLY, Printed	1	
-58	41084-0001	. . . TAPE, Dial readout	1	
-59	40956-0000	. . . WHEEL, Counter	1	
-60	40959	. . . SHAFT	1	
-61	17768-0000	. . SHIM, sst, 0.128 ID by 0.187 OD by 0.003 in. thk	AR	
-62	40957	. . WHEEL ASSEMBLY, Printed	1	
-63	41084-0000	. . . TAPE, Dial readout	1	
-64	40956-0002	. . . WHEEL, Counter	1	
-65	40967	. . . SHAFT	1	
-66	17768-0000	. . SHIM, sst, 0.128 ID by 0.187 OD by 0.003 in. thk	AR	
-67	41087	. . WHEEL ASSEMBLY, Printed	1	
-68	41084-0002	. . . TAPE, Dial readout	1	
-69	40956-0001	. . . WHEEL, Counter	1	
-70	40966	. . . SHAFT	1	
-71	34614-1102	. INDUCTOR, R.F., shielded, 1000 uH ±10 percent	1	
-72	40248-1213	. CAPACITOR, Fixed, tantalum, 15 uF ±10 percent, 20 Vdc (56289 part no. 196D156X9020KA1)	1	
-73	50184-0007	. STRIP, Terminal	1	
		ATTACHING PARTS		
-74	102-0012	. SCREW, Machine, bind. hd, brs, ni pl, No. 2-56NC-2A thd by 3/16 in. lg	1	
-75	4421	. NUT, Hexagon, brs, ni pl, No. 2-56NC-2B thd	1	
-76	7001	. WASHER, Lock, int tooth, brz, ni pl, No. 2 (78189 part no 1902)	1	
		---*---		
-77	40402-0440	. NUT, Sheet spring (78553 part no. C11374-440)	4	
-78	41114	. BRACKET ASSEMBLY .	1	



6A Receiver, A9, Control Assembly, Exploded View

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-2 -32	39463	. COLLAR, Shaft	1	
		ATTACHING PARTS		
-33	303-0008	. SETSCREW, Fluted soc dr, cup pt, stl, cad pl, No. 3-48NC-3A thd by 1/8 in. lg	2	
		---*---		
-34	28476-0012	. RING, Retaining, external, crescent	1	
-35	36516-0075	. WASHER, Flat, sst	1	
-36	40977	. GEAR, Spur	1	
		ATTACHING PARTS		
-37	302-0008	. SETSCREW, Fluted, soc dr, cup pt, stl, cad pl, No. 2-56NC-3A thd by 1/8 in. lg	2	
		---*---		
-38	41082	. SHAFT	1	
-39	41077-0001	. SWITCH, Rotary, single	1	
		ATTACHING PARTS		
-40	COML	. NUT, Hexagon (supplied with index 35)	1	
-41	8540	. WASHER, Lock, int tooth, brz, ni pl (78189 part no. 1920-02)	1	
		---*---		
-42	41115	. GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-43	304-0006	. SETSCREW, Fluted soc dr, cup pt, stl, cad pl, No. 4-40NC-3A thd by 3/32 in. lg	1	
		---*---		
-44	17768-0000	. SHIM, sst, 0.128 ID by 0.187 OD by 0.003 in. thk	AR	
-45	33138-0055	. BEARING, Flanged (12639 part no. 127-55)	1	
-46	40974	. GEAR ASSEMBLY, Crown	1	
		ATTACHING PARTS		
-47	304-0006	. SETSCREW, Fluted soc dr, cup pt, stl, cad pl, No. 4-40NC-3A thd by 3/32 in. lg	2	
		---*---		
-48	41116	. GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-49	304-0006	. SETSCREW, Fluted soc dr, cup pt, stl, cad pl, No. 4-40NC-3A thd by 3/32 in. lg	1	
		---*---		
-50	28665-0025	. RING, Retaining (MS16624-1025)	1	
-51	21623	. WASHER, Flat, sst	AR	
-52	33138-0115	. BEARING, Flanged (12639 part no. 127-115)	1	
-53	40943	. COUNTER ASSEMBLY	1	
-54	28476-0012	. . RING, Retaining, external, crescent	2	
-55	17768-0000	. . SHIM, sst, 0.128 ID by 0.187 OD by 0.003 in. thk	AR	
-56	28665-0025	. . RING, Retaining (MS16624-1025)	1	
-57	41085	. . WHEEL ASSEMBLY, Printed	1	
-58	41084-0001	. . . TAPE, Dial readout	1	
-59	40956-0000	. . . WHEEL, Counter	1	
-60	40959	. . . SHAFT	1	
-61	17768-0000	. . SHIM, sst, 0.128 ID by 0.187 OD by 0.003 in. thk	AR	
-62	40957	. . WHEEL ASSEMBLY, Printed	1	
-63	41084-0000	. . . TAPE, Dial readout	1	
-64	40956-0002	. . . WHEEL, Counter	1	
-65	40967	. . . SHAFT	1	
-66	17768-0000	. . SHIM, sst, 0.128 ID by 0.187 OD by 0.003 in. thk	AR	
-67	41087	. . WHEEL ASSEMBLY, Printed	1	
-68	41084-0002	. . . TAPE, Dial readout	1	
-69	40956-0001	. . . WHEEL, Counter	1	
-70	40966	. . . SHAFT	1	
-71	34614-1102	. INDUCTOR, R.F., shielded, 1000 uH ±10 percent	1	
-72	40248-1213	. CAPACITOR, Fixed, tantalum, 15 uF ±10 percent, 20 Vdc (56289 part no. 196D156X9020KA1)	1	
-73	50184-0007	. STRIP, Terminal	1	
		ATTACHING PARTS		
-74	102-0012	. SCREW, Machine, bind. hd, brs, ni pl, No. 2-56NC-2A thd by 3/16 in. lg	1	
-75	4421	. NUT, Hexagon, brs, ni pl, No. 2-56NC-2B thd	1	
-76	7001	. WASHER, Lock, int tooth, brz, ni pl, No. 2 (78189 part no 1902)	1	
		---*---		
-77	40402-0440	. NUT, Sheet spring (78553 part no. C11374-440)	4	
-78	41114	. BRACKET ASSEMBLY .	1	

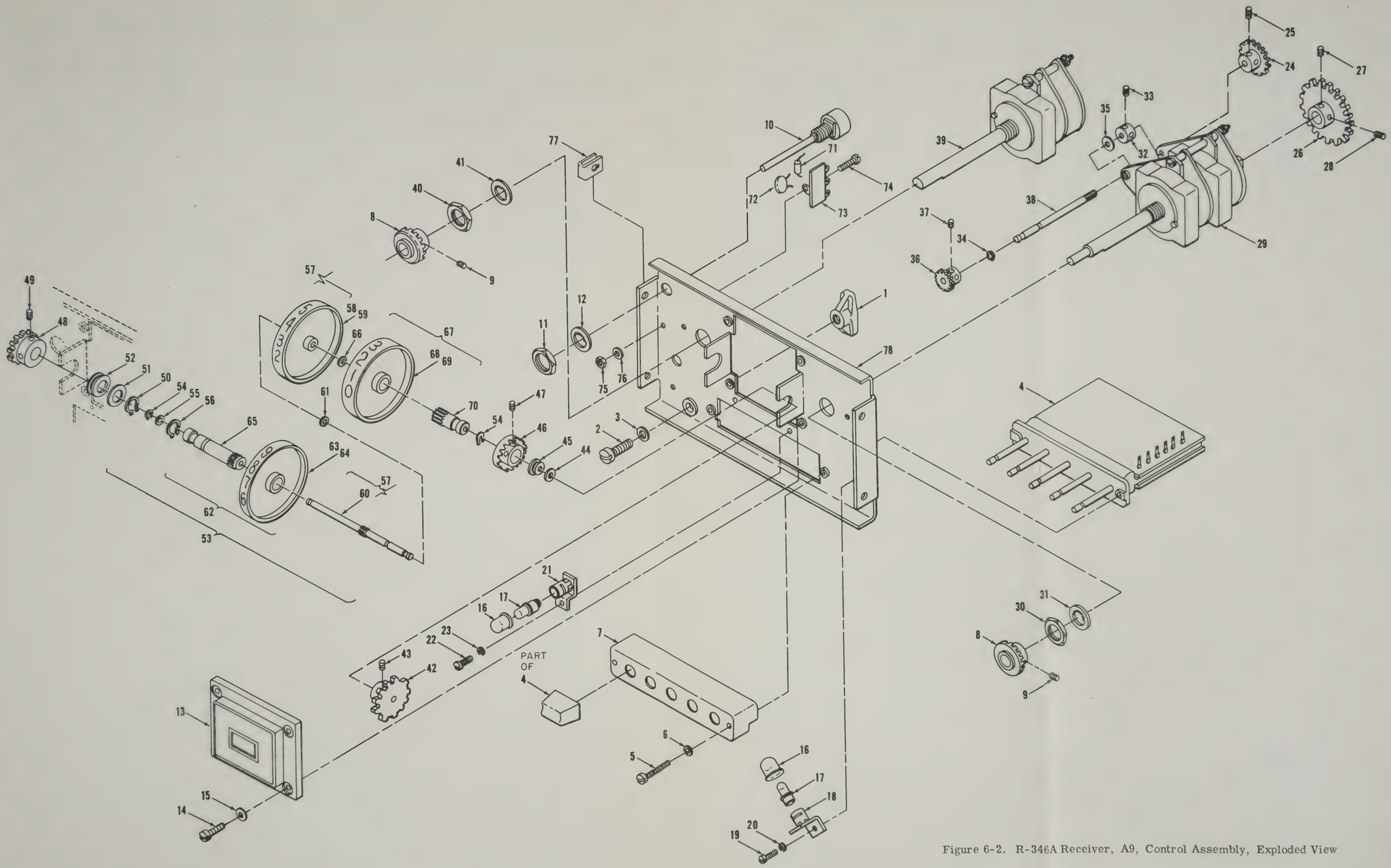
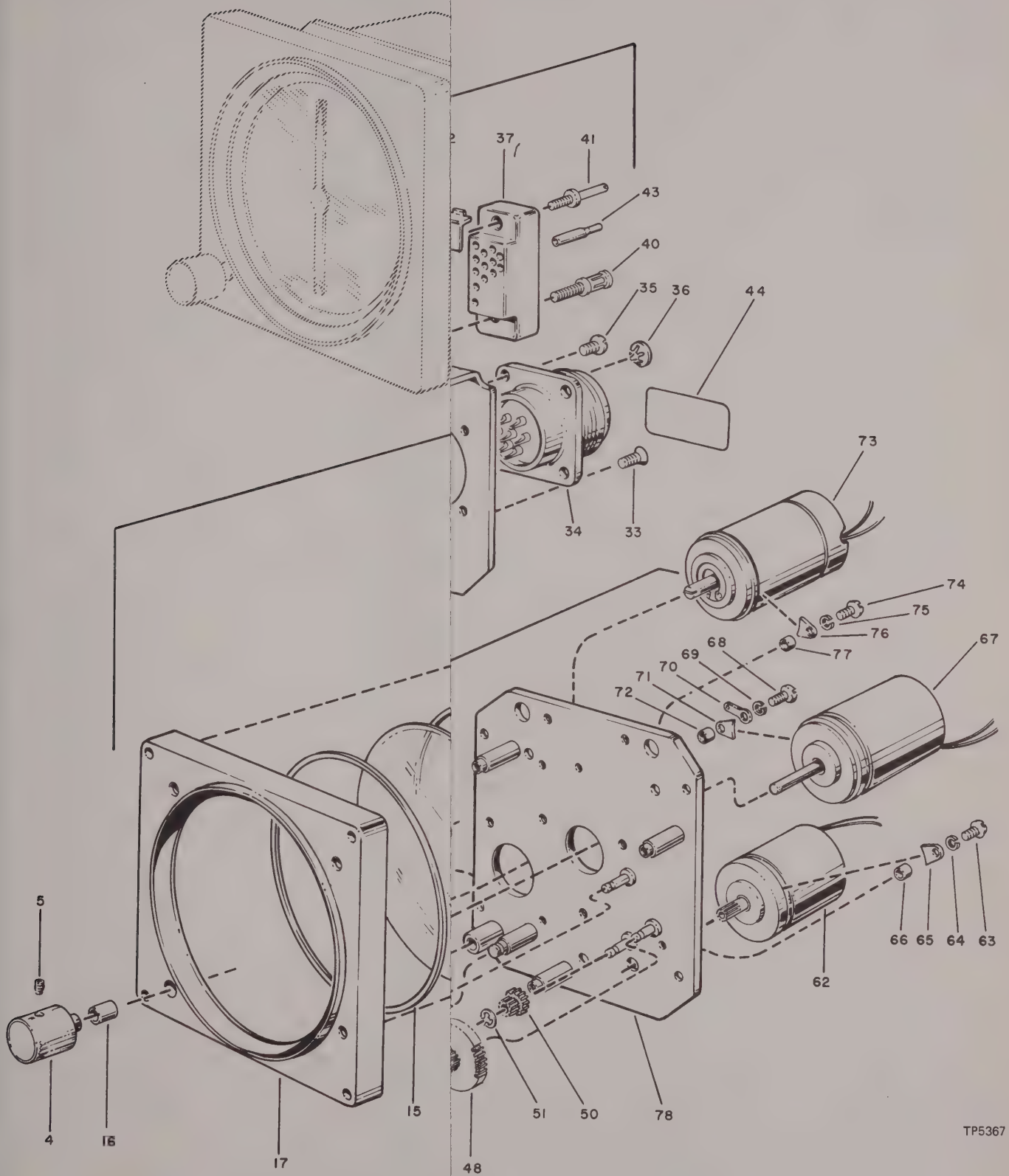


Figure 6-2. R-346A Receiver, A9, Control Assembly, Exploded View

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-2A -	40980-1000	GONIOMETER-INDICATOR ASSEMBLY, IN-346A	1	A
	40980-1001	GONIOMETER-INDICATOR ASSEMBLY, IN-346A	1	B
	40980-1100	GONIOMETER-INDICATOR ASSEMBLY, IN-346B	1	C
	40980-1101	GONIOMETER-INDICATOR ASSEMBLY, IN-346B	1	D
- 1	41347-0001	. PLATE, Information	1	
- 2	32775-0001	. COVER	1	
		ATTACHING PARTS		
- 3	514-0016	. SCREW, Assembled washer, bind hd, brs screw, sst lockwasher, blk oxidized No. 4-40 thd by 1/4 in. lg (78189 type SEMS)	2	
		---*---		
- 4	41503	. KNOB	1	
		ATTACHING PARTS		
- 5	324-4008	. SETSCREW, Hex soc dr, cup pt, stl, No. 4-40 thd by 1/8 in. lg	2	
		---*---		
- 6	104-0056	. SCREW, Machine, bind hd, brs, ni pl, No. 4-40 thd by 7/8 in. lg	4	
- 7	22341	. WASHER, Lock, split, sst, No. 4	4	
- 8	42096	. SPACER, Sleeve	4	
- 9	41457-0003	. MASK, Printed	1	
		ATTACHING PARTS		
-10	102-0012	. SCREW, Machine, bind hd, brs, ni pl, No. 2-56 thd by 3/16 in. lg	4	
		---*---		
-11	35597-0000	. GASKET	AR	
-12	41451-0000	. WEDGE	1	B, D
-12	41451-0001	. WEDGE, Printed	1	A, C
-13	35597-0000	. GASKET	AR	
-14	41450	. WEDGE, Round	1	
-15	35597-0000	. GASKET	AR	
-16	41506	. BEARING	1	
-17	41403-0001	. BEZEL, Machined	1	
-18	28775-0005	. POINTER ASSEMBLY	1	B, D
-18	28775-0006	. POINTER ASSEMBLY	1	A, C
-19	41449-0001	. DIAL	1	B, D
-19	41449-0002	. DIAL	1	A, C
		ATTACHING PARTS		
-20	102-0012	. SCREW, Machine, bind hd, brs, ni pl, No. 2-56 thd by 3/16 in. lg	3	
-21	41518	. SPRING	3	
		---*---		
-22	37226-0002	. FILTER, Lamp (22921 part no. D152-100-9)	2	
-23	39847-0336	. LAMP, Incandescent, miniature (08806 part no. 336)	2	
-24	41097-0212	. LAMPHOLDER, Midget (95263 part no. 25-212)	2	
		ATTACHING PARTS		
-25	40468-4016	. SCREW, Tapping, thd forming, slot dr, pan hd stl, cad pl, No. 4-40 thd by 1/4 in. lg	2	
-26	22341	. WASHER, Lock, split, sst, No. 4	2	
		---*---		
-27	41302	. CONTACT ASSEMBLY, Molded	1	
		ATTACHING PARTS		
-28	102-0032	. SCREW, Machine, fh, brs, ni pl, No. 2-56 thd by 1/2 in. lg	2	
-29	29898-3002	. WASHER, Lock, brz, cad pl, No. 2 (AN935B2L)	2	
		---*---		
-30	41524	. BRACKET ASSEMBLY	1	
		ATTACHING PARTS		
-31	504-0024	. SCREW, Assembled washer, bind hd, ni pl, brs screw, sst lockwasher No. 4-40 thd by 3/8 in. lg (78189 type SEMS)	3	
		---*---		
-32	41509	. SPACER	1	
		ATTACHING PARTS		
-33	144-0016	. SCREW, Machine, fh, brs, ni pl, No. 4-40 thd by 1/4 in. lg	1	
		---*---		

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-2A -34	31169-0000	. CONNECTOR, Receptacle, electrical (J1) (MS3102R16S-1P)	1	
		ATTACHING PARTS		
-35	339-4020	. SCREW, Tapping, thd forming, phillips dr, pan hd, stl, cad pl, . . .	4	
		No. 4 by 5/16 in. lg		
		---*---		
-36	30455-0031	. PLUG, Button	1	
-37	35860-0118	. CONNECTOR BODY, Receptacle, electrical (J2)	1	
		ATTACHING PARTS		
-38	—	. NUT, Hexagon (supplied with 35862-0001 and -0002)	2	
-39	—	. WASHER, Lock (supplied with 35862-0001 and -0002)	2	
-40	35862-0001	. GUIDE SOCKET	1	
-41	35862-0002	. GUIDE PIN	1	
-42	29916-0001	. TABS, Lock (1 set)	1	
		---*---		
-43	35861-0122	. CONTACT, Electrical	18	
-44	40982-1001	. PLATE, Identification	1	A, B
-44	40982-1100	. PLATE, Identification	1	C
-44	40982-1101	. PLATE, Identification	1	D
-45	41517-0000	. GEARING UNIT ASSEMBLY.	1	A, B
-45	41517-0001	. GEARING UNIT ASSEMBLY	1	C, D
-46	41529	. . GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-47	30323-0009	. . RING, Retaining (79136 part no. 5133-9-MD) (MS16633-1009). . . .	1	
		---*---		
-48	41528	. . GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-49	30323-0009	. . RING, Retaining (79136 part no. 5133-9-MD) (MS16633-1009). . . .	1	
		---*---		
-50	41527	. . GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-51	30323-0009	. . RING, Retaining (79136 part no. 5133-9-MD) (MS16633-1009). . . .	1	
		---*---		
-52	41526	. . GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-53	304-0006	. . SETSCREW, Spline soc dr, cup pt, stl, cad pl, ...	2	
		No. 4-40 thd by 3/32 in. lg		
		---*---		
-54	41532	. . GEAR ASSEMBLY	1	C, D
		ATTACHING PARTS		
-55	304-0006	. . SETSCREW, Spline soc dr, cup pt, stl, cad pl, ...	2	C, D
		No. 4-40 thd by 3/32 in. lg		
		---*---		
-56	41476	. . GEAR	1	
		ATTACHING PARTS		
-57	30323-0009	. . RING, Retaining (79136 part no. 5133-9-MD) (MS16633-1009). . . .	1	
		---*---		
-58	41531	. . GEAR AND SHAFT ASSEMBLY	1	
		ATTACHING PARTS		
-59	30323-0009	. . RING, Retaining (79136 part no. 5133-9-MD) (MS16633-1009) . . .	1	
-60	13527	. . WASHER, Spring	1	
-61	17768-0000	. . SHIM, sst, 0.128 ID by 0.187 OD by 0.003 in. thk	AR	
		---*---		
-62	40963	. . MOTOR, Control	1	
		ATTACHING PARTS		
-63	163-0020	. . SCREW, Machine, fil hd, brs, ni pl, No. 3-48 thd by 5/16 in. lg . .	2	
-64	4559	. . WASHER, Lock, split, brz, ni pl, No. 3	2	
-65	26804-0000	. . CLAMP, Rim clenching.	2	
-66	26805-0001	. . SPACER, Sleeve	2	
		---*---		

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-2A -67	37483-0000	. . GONIOMETER, Electrical (28308 part no. 10Hew0101/B02/0216) . .	1	
-68	163-0020	. . SCREW, Machine, fil hd, brs, ni pl, No. 3-48 thd by 5/16 in. lg . .	3	
-69	4559	. . WASHER, Lock, split, brz, ni pl, No. 3	3	
-70	3873	. . TERMINAL	1	
-71	26804-0000	. . CLAMP, Rim clenching	3	
-72	26805-0004	. . SPACER, Sleeve	3	
-73	18008	. . SYNCHRO, Transmitter, 26 V, 400 Hz, 13 V, 100 Hz . . . . . (88818 part no. RS9114A)	1	C, D
		ATTACHING PARTS		
-74	163-0020	. . SCREW, Machine, fil hd, brs, ni pl, No. 3-48 thd by 5/16 in. lg . .	2	C, D
-75	4559	. . WASHER, Lock, split, brz, ni pl, No. 3	2	C, D
-76	26804-0000	. . CLAMP, Rim clenching.	2	C, D
-77	26805-0006	. . SPACER, Sleeve	2	C, D
		---*---		
-78	41523-0000	. . PLATE ASSEMBLY	1	C, D
-78	41523-0001	. . PLATE ASSEMBLY	1	A, B



Goniometer Indicators, Exploded View

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-2A -67	37483-0000	. . GONIOMETER, Electrical (28308 part no. 10Hew0101/B02/0216) . .	1	
-68	163-0020	. . SCREW, Machine, fil hd, brs, ni pl, No. 3-48 thd by 5/16 in. lg . .	3	
-69	4559	. . WASHER, Lock, split, brz, ni pl, No. 3	3	
-70	3873	. . TERMINAL	1	
-71	26804-0000	. . CLAMP, Rim clenching	3	
-72	26805-0004	. . SPACER, Sleeve	3	
-73	18008	. . SYNCHRO, Transmitter, 26 V, 400 Hz, 13 V, 100 Hz	1	C, D
		(88818 part no. RS9114A)		
		ATTACHING PARTS		
-74	163-0020	. . SCREW, Machine, fil hd, brs, ni pl, No. 3-48 thd by 5/16 in. lg . .	2	C, D
-75	4559	. . WASHER, Lock, split, brz, ni pl, No. 3	2	C, D
-76	26804-0000	. . CLAMP, Rim clenching	2	C, D
-77	26805-0006	. . SPACER, Sleeve	2	C, D
		---*---		
-78	41523-0000	. . PLATE ASSEMBLY	1	C, D
-78	41523-0001	. . PLATE ASSEMBLY	1	A, B

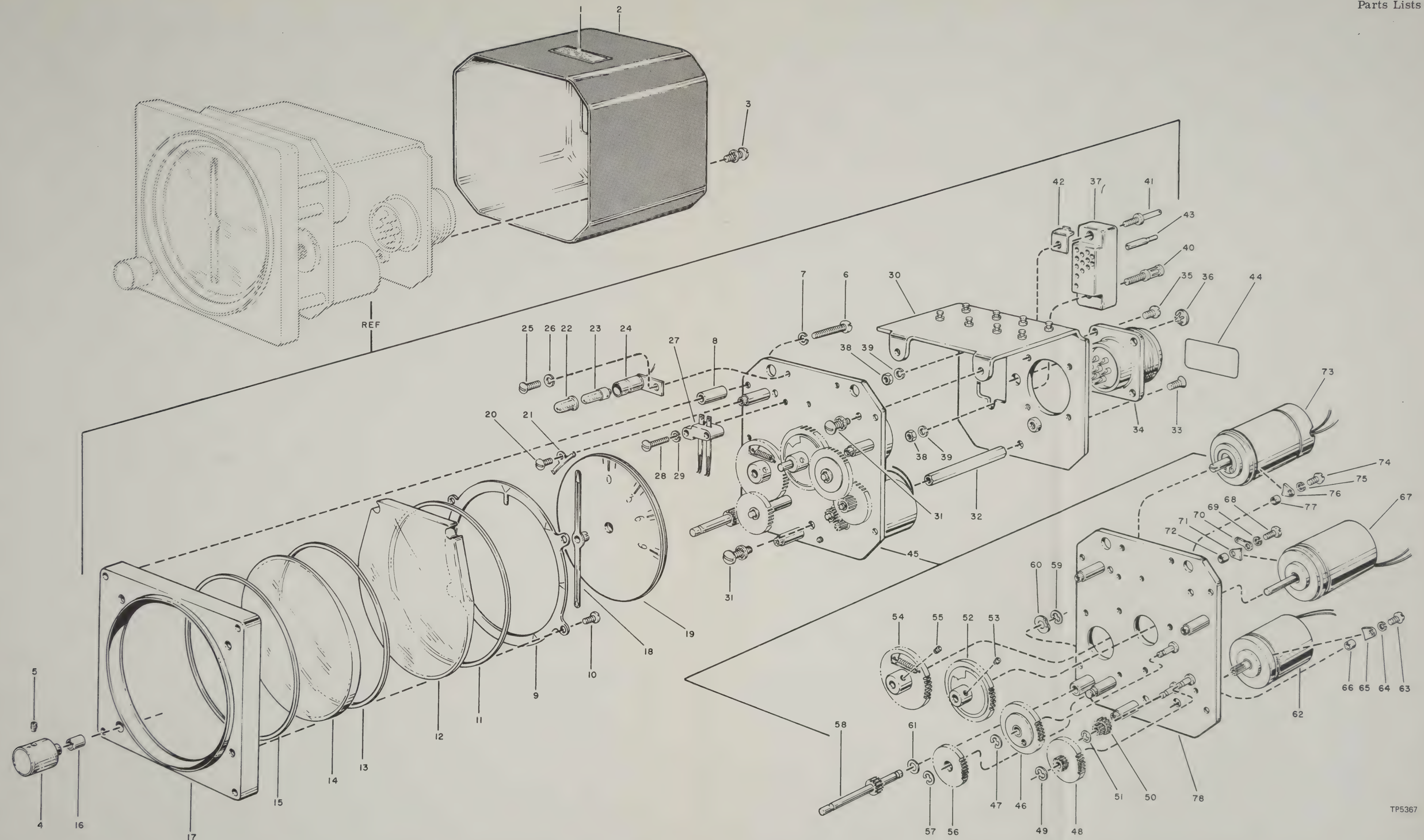


Figure 6-2A. IN-346A and IN-346B Goniometer Indicators, Exploded View

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-3 -	41360-1001	GONIOMETER-INDICATOR ASSEMBLY, IN-346C	1	
-1	34716-0001	. PLATE, Information	1	
-2	33277	. COVER	1	
		ATTACHING PARTS		
-3	514-0016	. SCREW, Assembled washer, bind hd, brs screw, sst lockwasher, blk oxidized, No. 4-40 thd by 1/4 in. lg (78189 type SEMS)	2	
		---*---		
-4	35860-0118	. CONNECTOR, Receptacle, electrical (J2)	1	
		ATTACHING PARTS		
-5	29916-0001	. TABS, Lock (1 set)	1	
		---*---		
-6	35862-0001	. GUIDE, Socket	1	
-7	35862-0002	. GUIDE, Pin	1	
-8	31169-0000	. CONNECTOR, Receptacle, electrical (J1) (MS3102R16S-1P)	1	
		ATTACHING PARTS		
-9	504-0024	. SCREW, Assembled washer, bind hd, brs screw, ni pl, sst lockwasher, No. 4-40 thd by 3/8 in. lg (78189 type SEMS)	4	
		---*---		
-10	41361-1001	. PLATE, Identification (used on IN-346C, part no. 41360-1001)	1	
-11	41291	. PLATE ASSEMBLY	1	
		ATTACHING PARTS		
-12	144-0016	. SCREW, Machine, fh, brs, ni pl, No. 4-40 thd by 1/4 in. lg	1	
-13	8775-0016	. PIN, Spring (MS171432)	2	
		---*---		
-14	33281-0001	. PLATE, Printed	1	
		ATTACHING PARTS		
-15	504-0040	. SCREW, Assembled washer, bind hd, brs screw, ni pl, sst lockwasher, No. 4-40 thd by 5/8 in. lg (78189 type SEMS)	3	
-16	104-0040	. SCREW, Machine, bind. hd, brs ni pl, No. 4-40 thd by 5/8 in. lg	1	
-17	8927-0004	. TERMINAL, Lug, locking	1	
		---*---		
-18	29609-0026	. SPACER	4	
-19	33273	. BLOCK	1	
		ATTACHING PARTS		
-20	504-0016	. SCREW, Assembled washer, bind hd, brs screw, ni pl, sst lockwasher, No. 4-40 by 1/4in. lg (78189 type SEMS)	2	
		---*---		
-21	20097-0134	. POST	1	
		ATTACHING PARTS		
-22	504-0016	. SCREW, Assembled washer, bind hd, brs screw, ni pl, sst lockwasher, No. 4-40 by 1/4 in. lg (78189 type SEMS)	1	
		---*---		
-23	33245-0001	. CAM ASSEMBLY	1	
		ATTACHING PARTS		
-24	504-0016	. SCREW, Assembled washer, bind hd, brs screw, ni pl, sst lockwasher, No. 4-40 by 1/4 in. lg (78189 type SEMS)	4	
		---*---		
-25	33228	. FIDUCIAL	1	
		ATTACHING PARTS		
-26	502-0016	. SCREW, Assembled washer, bind hd, brs screw, ni pl, sst lockwasher, No. 2-56 by 1/4 in. lg (78189 type SEMS)	2	
		---*---		
-27	33076	. FLANGE ASSEMBLY	1	
		ATTACHING PARTS		

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-3 -28	174-0028	. SCREW, Machine, fil h, brs, blk oxidized, No. 4-40 thd by 7/16 in. lg	8	
-29	29519	. WASHER, Lock, split, stl, cad pl, No. 4 ---*---	8	
-30	11816	. WASHER, Spring tension	1	
-31	20249	. WASHER	1	
-32	26050	. WINDOW	1	
-33	20250	. GASKET (89944 part no. 611KN-27)	1	
-34	34147-0002	. POINTER ASSEMBLY	1	
-34	34147-0003	. POINTER ASSEMBLY	1	
-35	20261	. RING, Snap	1	
-36	34153	. MASK, Painted	1	
-37	34140-0002	. DIAL	1	
-37	34140-0003	. DIAL ATTACHING PARTS	1	
-38	152-0012	. SCREW, Machine, bind. hd, brs, blk oxidized, No. 2-56 by 3/16 in. lg ---*---	4	
-39	39021-0002	. PLATE, Filter (blue)	1	
-40	35156-0002	. PLATE ATTACHING PARTS	1	
-41	142-0016	. SCREW, Machine, fh, brs, ni pl, No. 2-56 thd by 1/4 in. lg ---*---	4	
-42	34144	. GEAR, Spur	1	
-43	33083	. WASHER, Formed	1	
-44	41306-000	. GEARING UNIT ASSEMBLY	1	
-45	33084-0002	. . PLATE ASSEMBLY ATTACHING PARTS	1	
-46	104-0020	. . SCREW, Machine, bind. hd, brs, ni pl, No. 4-40 thd by 5/16 in. lg	3	
-47	104-0024	. . SCREW, Machine, bind. hd, brs, ni pl, No. 4-40 thd by 3/8 in. lg ---*---	3	
-48	34155	. . FLANGE	1	
-49	33089	. . GEAR ASSEMBLY ATTACHING PARTS	1	
-50	28665-0012	. . RING, Retaining (79136 part no. 5100-12-C)	1	
-51	17768	. . SHIM, sst, 0.128 ID by 0.187 OD by 0.003 in. thk ---*---	AR	
-52	39091	. . PRINTED CIRCUIT ASSEMBLY ATTACHING PARTS	1	
-53	502-0012	. . SCREW, Assembled washer, bind. hd, brs screw, ni pl, sst lockwasher, No. 2-56 thd by 3/16 in. lg	3	
-54	3873	. . TERMINAL ---*---	1	
-55	39013-2182	. . . LAMP, Incandescent, 14 V (08806 part no. 2182D-FROSTED)	4	
-56	39090	. . . PRINTED CIRCUIT SUBASSEMBLY	1	
-57	7117	. . WASHER, Flat, sst, 0.192 ID by 0.281 OD by 0.005 in. thk	AR	
-58	28665-018	. . RING, Retaining (79136 part no. 5100-18-C)	1	
-59	33270	. . GEAR ASSEMBLY ATTACHING PARTS	1	
-60	302-0006	. . SETSCREW, Fluted soc dr, cup pt, stl, cad pl, No. 2-56 thd by 3/32 in. lg ---*---	2	
-61	33093	. . POST	3	
-62	41302	. . CONTACT ASSEMBLY, Molded ATTACHING PARTS	1	
-63	142-0032	. . SCREW, Machine, fh, brs, ni pl, No. 2-56 thd by 1/2 in. lg	2	
-64	4386	. . WASHER, Lock, split, brz, ni pl, No. 2	2	
-65	8275	. . NUT, Hexagon, brs, ni pl, No. 2-56 thd, 0.156 in. across flats, 0.050 in. thk ---*---	2	
-66	33148	. . GEAR ASSEMBLY ATTACHING PARTS	1	

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-3 -67	302-0006	. . SETSCREW, Fluted soc dr, cup pt, stl, cad pl, ... No. 2-56 thd by 3/32 in. lg	2	
		---*---		
-68	33129	. . GEAR ASSEMBLY	1	
-69	33127	. . GEAR ASSEMBLY	1	
-70	33694	. . GEAR ASSEMBLY	1	
-71	41304	. . GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-72	304-0006	. . SETSCREW, Fluted soc dr, cup pt, stl, cad pl, ... No. 4-40 thd by 3/32 in. lg	2	
		---*---		
-73	41303	. . CONTACT PLATE ASSEMBLY	1	
		ATTACHING PARTS		
-74	304-0006	. . SETSCREW, Fluted soc dr, cup pt, stl, cad pl, ... No. 4-40 thd by 3/32 in. lg	2	
		---*---		
-75	41293	. . SHAFT	1	
		ATTACHING PARTS		
-76	28476-0012	. . RING, Retaining	2	
-77	17768	. . SHIM, sst, 0.128 in. ID by 0.187 in. OD . . . . . by 0.003 in. thk	AR	
		---*---		
-78	41325	. . PLATE ASSEMBLY	1	
		ATTACHING PARTS		
-79	163-0020	. . SCREW, Machine, fil hd, brs, ni pl, ... No. 3-48 thd by 5/16 in. lg	1	
-80	4559	. . WASHER, Lock, split brz, ni pl, No. 3	1	
		---*---		
-81	40963	. . MOTOR, Control	1	
		ATTACHING PARTS		
-82	163-0020	. . SCREW, Machine, fil hd, brs, ni pl, ... No. 3-48 thd by 5/16 in. lg	2	
-83	4559	. . WASHER, Lock, split, brz, ni pl, No. 3	2	
-84	4644	. . WASHER	2	
-85	38409-0002	. . CLAMP, Rim clenching	2	
		---*---		
-86	37483-0000	. . GONIOMETER, Electrical (28308) part no. . . . . 10Hew0101/B02/0216)	1	
-86	37483-0001	. . GONIOMETER, Electrical (28308) part no. . . . . 10Hew0101/B05/0216) (alternate part for 37483-0000)	1	
		ATTACHING PARTS		
-87	163-0024	. . SCREW, Machine, fil hd, brs, ni pl, ... No. 3-48 thd by 3/8 in. lg	3	
-88	4559	. . WASHER, Lock, split, brz, ni pl, No. 3	3	
-89	26804-0000	. . CLAMP, Rim clenching	3	
-90	26805-0004	. . SPACER, Sleeve	3	
		---*---		
-91	33489-0002	. . PLATE ASSEMBLY, Front	1	
-92	33227	. . GEAR, Spur	1	
		ATTACHING PARTS		
-93	302-0006	. . SETSCREW, Fluted soc dr, cup pt, stl, cad pl, ... No. 2-56 thd by 3/32 in. lg	2	
		---*---		
-94	33152	. . GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-95	302-0006	. . SETSCREW, Fluted soc dr, cup pt, stl, cad pl, ... No. 2-56 thd by 3/32 in. lg	2	
		---*---		
-96	33094	. . POST	3	
-97	33243	. . POST	4	
-98	33205	. . GEARING ASSEMBLY	1	
		ATTACHING PARTS		
-99	28665-0025	. . RING, Retaining (79136 part no. 5100-25-MD)	1	
-100	21623	. . WASHER, Flat, 0.257 ID by 0.344 OD by 0.003 in. thk	1	
		---*---		
-101	29857	. . . ARM ASSEMBLY	1	
		ATTACHING PARTS		

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-3 -102	102-0012	. . . SCREW, Machine, bind. hd, brs, ni pl, ... No. 2-56 thd by 3/16 in. lg	1	
		---*---		
-103	29848	. . . PIN, Grooved, headed	1	
		ATTACHING PARTS		
-104	28665-0012	. . . RING, Retaining (79136 part no. 5100-12-C)	1	
-105	17768	. . . SHIM, sst, 0.128 ID by 0.187 OD by 0.003 in. thk	1	
		---*---		
-106	29849	. . . SPRING, Helical, torsion	1	
-107	33248	. . . DIAL, Printed	1	
		ATTACHING PARTS		
-108	502-0008	. . . SCREW, Assembled washer, bind. hd, brs screw, ... ni pl, sst lockwasher, No. 2-56 thd by 1/8 in. lg (78189 type SEMS)	2	
		---*---		
-109	33207	. . . PIN, Shoulder.	1	
-110	30995	. . . WASHER, Flat, sst, 0.380 ID by 0.500 OD by . . . . . 0.040 in. thk	1	
-111	17831	. . . SPRING, Helical, extension	1	
-112	29852	. . . GEAR, Spur	1	
-113	30314	. . . GEAR, Spur	1	
-114	30996	. . . WASHER, Flat, sst, 0.281 ID by 0.500 OD by 0.062 in. thk . . .	1	
-115	8775-0442	. . . PIN, Spring	1	
-116	33208	. . . PLATE ASSEMBLY	1	
-117	33224	. . GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-118	28665-0018	. . RING, Retaining (79136 part no. 5100-18-C)	1	
-119	7117	. . WASHER, Flat, sst, 0.192 ID by 0.281 OD by 0.005 in. thk	AR	
		---*---		
-120	33533-0001	. . PLATE ASSEMBLY, Rear	1	

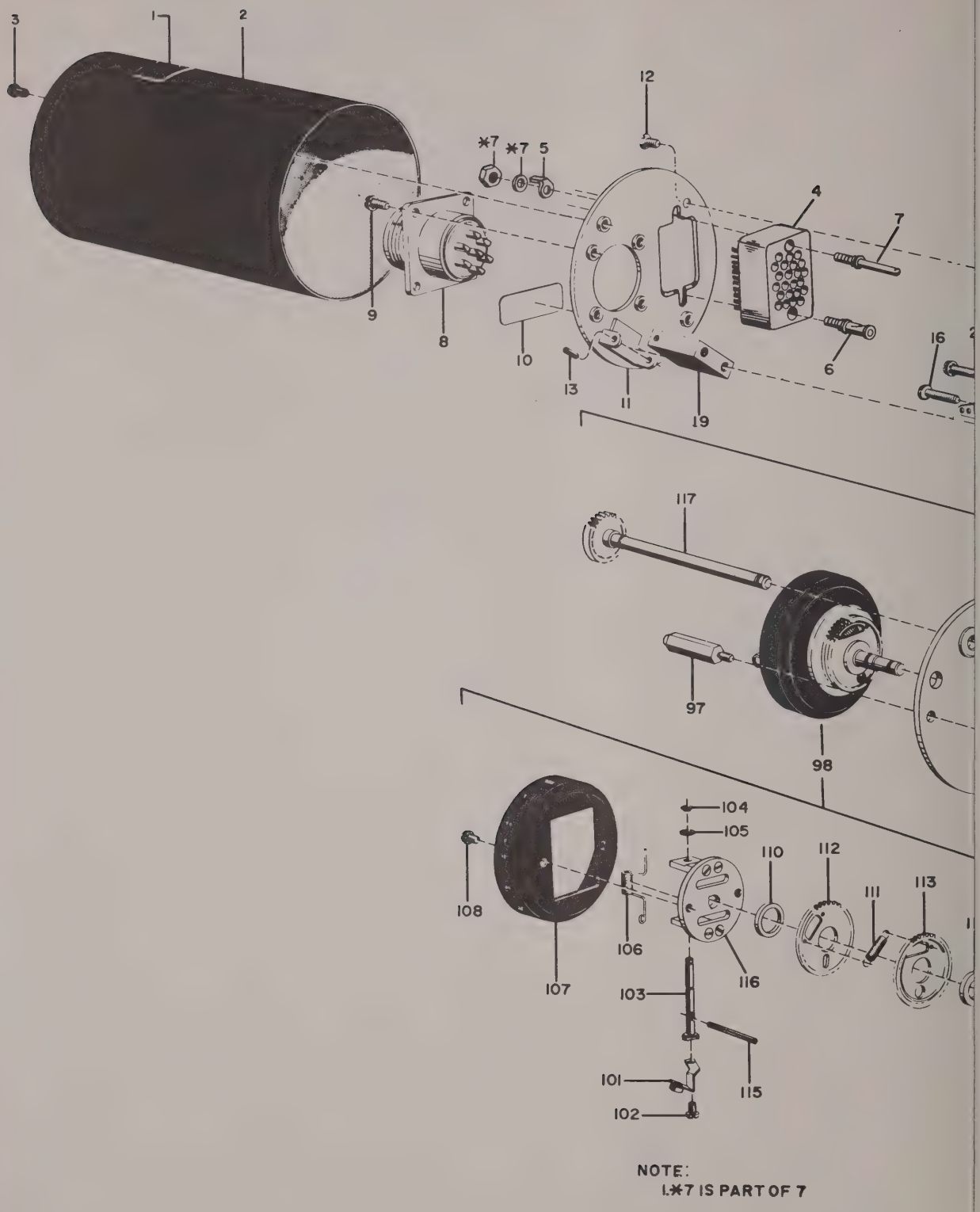


Figure 6-3. IN-346C Goniometer-Indicator, Exploded View

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-3A -	41360-1000	GONIOMETER-INDICATOR ASSEMBLY, IN-346C	1	E
	41360-1001	GONIOMETER-INDICATOR ASSEMBLY, IN-346C	1	F
	41360-1100	GONIOMETER-INDICATOR ASSEMBLY, IN-346D	1	G
	41360-1101	GONIOMETER-INDICATOR ASSEMBLY, IN-346D	1	H
- 1	41347-0001	. PLATE, Information	1	
- 2	33277	. COVER	1	
		ATTACHING PARTS		
- 3	514-0016	. SCREW, Assembled washer, bind hd, brs screw, sst lockwasher, blk oxidized No. 4-40 thd by 1/4 in. lg (78189 type SEMS)	2	
		---*---		
- 4	35860-0118	. CONNECTOR BODY, Receptacle, electrical (J2)	1	
		ATTACHING PARTS		
- 4A	—	. NUT, Hexagon (supplied with 35862-0001 and -0002)	2	
- 4B	—	. WASHER, Lock (supplied with 35862-0001 and -0002)	2	
- 5	35862-0002	. GUIDE, Pin	1	
- 6	35862-0001	. GUIDE, Socket	1	
- 7	29916-0001	. TABS, Lock (1 set)	1	
		---*---		
- 8	35861-0122	. CONTACT, Electrical	16	
- 9	35861-0118	. CONTACT, Electrical	2	
-10	31169-0000	. CONNECTOR, Receptacle, electrical (J1) (MS3102R16S-1P)	1	
		ATTACHING PARTS		
-11	504-0024	. SCREW, Assembled washer, bind hd, ni pl, brs screw, sst lockwasher No. 4-40 thd by 3/8 in. lg (78189 type SEMS)	4	
		---*---		
-12	41361-1000	. PLATE, Identification	1	E
-12	41361-1001	. PLATE, Identification	1	F
-12	41361-1100	. PLATE, Identification	1	G
-12	41361-1101	. PLATE, Identification	1	H
-13	41291	. PLATE ASSEMBLY	1	
		ATTACHING PARTS		
-14	144-0016	. SCREW, Machine, fh, brs, ni pl, No. 4-40 thd by 1/4 in. lg	1	
-15	8775-0016	. PIN, Spring (MS171432)	2	
		---*---		
-16	33281-0001	. PLATE, Printed	1	
		ATTACHING PARTS		
-17	504-0040	. SCREW, Assembled washer, bind hd, ni pl, brs screw, sst lockwasher No. 4-40 thd by 5/8 in. lg (78189 type SEMS)	3	
-18	104-0040	. SCREW, Machine, bind hd, brs, ni pl, No. 4-40 thd by 5/8 in. lg	1	
-19	8927-0004	. TERMINAL, Lug, locking	1	
		---*---		
-20	29609-0026	. SPACER	4	
-21	33273	. BLOCK	1	
		ATTACHING PARTS		
-22	504-0016	. SCREW, Assembled washer, bind hd, ni pl, brs screw, sst lockwasher No. 4-40 thd by 1/4 in. lg (78189 type SEMS)	2	
		---*---		
-23	33245-0001	. CAM ASSEMBLY	1	
		ATTACHING PARTS		
-24	504-0016	. SCREW, Assembled washer, bind hd, ni pl, brs screw, sst lockwasher No. 4-40 thd by 1/4 in. lg (78189 type SEMS)	2	
		---*---		
-25	20097-0134	. POST	1	
		ATTACHING PARTS		
-26	504-0016	. SCREW, Assembled washer, bind hd, ni pl, brs screw, sst lockwasher No. 4-40 thd by 1/4 in. lg (78189 type SEMS)	1	
		---*---		

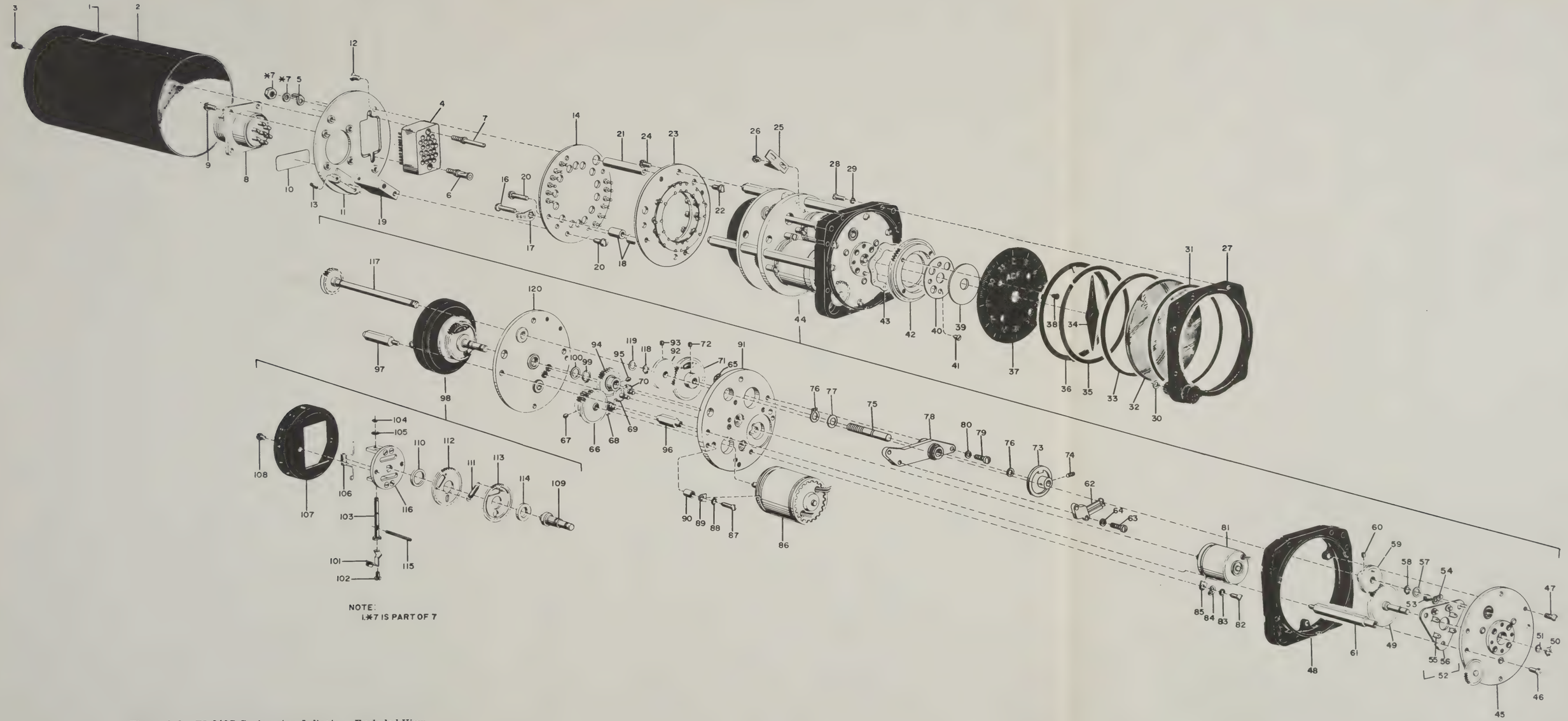


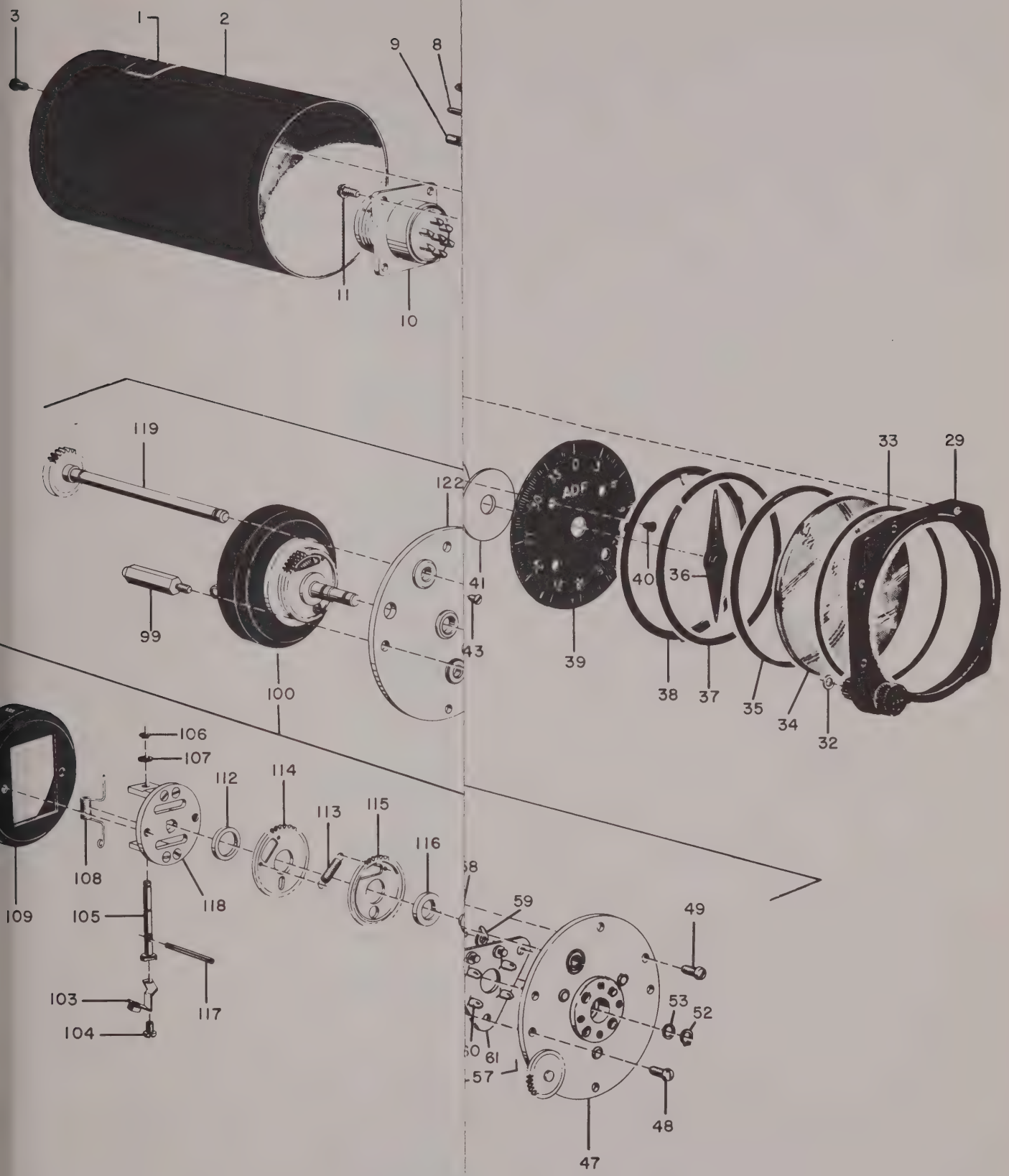
Figure 6-3. IN-346C Goniometer-Indicator, Exploded View

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-3A -	41360-1000	GONIOMETER-INDICATOR ASSEMBLY, IN-346C	1	E
	41360-1001	GONIOMETER-INDICATOR ASSEMBLY, IN-346C	1	F
	41360-1100	GONIOMETER-INDICATOR ASSEMBLY, IN-346D	1	G
	41360-1101	GONIOMETER-INDICATOR ASSEMBLY, IN-346D	1	H
- 1	41347-0001	. PLATE, Information	1	
- 2	33277	. COVER	1	
		ATTACHING PARTS		
- 3	514-0016	. SCREW, Assembled washer, bind hd, brs screw, sst lockwasher, blk oxidized No. 4-40 thd by 1/4 in. lg (78189 type SEMS)	2	
		---*---		
- 4	35860-0118	. CONNECTOR BODY, Receptacle, electrical (J2)	1	
		ATTACHING PARTS		
- 4A	—	. NUT, Hexagon (supplied with 35862-0001 and -0002)	2	
- 4B	—	. WASHER, Lock (supplied with 35862-0001 and -0002)	2	
- 5	35862-0002	. GUIDE, Pin	1	
- 6	35862-0001	. GUIDE, Socket	1	
- 7	29916-0001	. TABS, Lock (1 set)	1	
		---*---		
- 8	35861-0122	. CONTACT, Electrical	16	
- 9	35861-0118	. CONTACT, Electrical	2	
-10	31169-0000	. CONNECTOR, Receptacle, electrical (J1) (MS3102R16S-1P)	1	
		ATTACHING PARTS		
-11	504-0024	. SCREW, Assembled washer, bind hd, ni pl, brs screw, sst lockwasher No. 4-40 thd by 3/8 in. lg (78189 type SEMS)	4	
		---*---		
-12	41361-1000	. PLATE, Identification	1	E
-12	41361-1001	. PLATE, Identification	1	F
-12	41361-1100	. PLATE, Identification	1	G
-12	41361-1101	. PLATE, Identification	1	H
-13	41291	. PLATE ASSEMBLY	1	
		ATTACHING PARTS		
-14	144-0016	. SCREW, Machine, fh, brs, ni pl, No. 4-40 thd by 1/4 in. lg	1	
-15	8775-0016	. PIN, Spring (MS171432)	2	
		---*---		
-16	33281-0001	. PLATE, Printed	1	
		ATTACHING PARTS		
-17	504-0040	. SCREW, Assembled washer, bind hd, ni pl, brs screw, sst lockwasher No. 4-40 thd by 5/8 in. lg (78189 type SEMS)	3	
-18	104-0040	. SCREW, Machine, bind hd, brs, ni pl, No. 4-40 thd by 5/8 in. lg	1	
-19	8927-0004	. TERMINAL, Lug, locking	1	
		---*---		
-20	29609-0026	. SPACER	4	
-21	33273	. BLOCK	1	
		ATTACHING PARTS		
-22	504-0016	. SCREW, Assembled washer, bind hd, ni pl, brs screw, sst lockwasher No. 4-40 thd by 1/4 in. lg (78189 type SEMS)	2	
		---*---		
-23	33245-0001	. CAM ASSEMBLY	1	
		ATTACHING PARTS		
-24	504-0016	. SCREW, Assembled washer, bind hd, ni pl, brs screw, sst lockwasher No. 4-40 thd by 1/4 in. lg (78189 type SEMS)	2	
		---*---		
-25	20097-0134	. POST	1	
		ATTACHING PARTS		
-26	504-0016	. SCREW, Assembled washer, bind hd, ni pl, brs screw, sst lockwasher No. 4-40 thd by 1/4 in. lg (78189 type SEMS)	1	
		---*---		

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-3A -27	33228	. FIDUCIAL	1	
		ATTACHING PARTS		
-28	502-0016	. SCREW, Assembled washer, bind hd ni pl, brs screw, sst lockwasher No. 2-56 by 1/4 in. lg (78189 type SEMS)	2	
		---*---		
-29	33076	. FLANGE ASSEMBLY	1	
		ATTACHING PARTS		
-30	174-0028	. SCREW, Machine, fil h, brs, blk oxidized, No. 4-40 thd by 7/16 in. lg	8	
-31	29519	. WASHER, Lock, split, stl, cad pl, No. 4	8	
		---*---		
-32	11816	. WASHER, Spring tension	1	
-33	20249	. WASHER	1	
-34	40764	. WINDOW	1	E, G
-34	26050	. WINDOW	1	F, H
-35	20250	. GASKET (89944 part no. 611KN-27)	1	
-36	34147-0002	. POINTER ASSEMBLY	1	E, G
-36	34147-0003	. POINTER ASSEMBLY	1	F, H
-37	20261	. RING, Snap	1	
-38	34153	. MASK, Painted	1	
-39	34140-0002	. DIAL	1	F, H
-39	34140-0003	. DIAL	1	E, G
		ATTACHING PARTS		
-40	152-0012	. SCREW, Machine, bind, hd, brs, blk oxidized, No. 2-56 by 3/16 in. lg	4	
		---*---		
-41	39021-0002	. PLATE, Filter (blue)	1	
-42	35156-0002	. PLATE	1	
		ATTACHING PARTS		
-43	142-0016	. SCREW, Machine, fh, brs, ni pl, No. 2-56 thd by 1/4 in. lg	4	
		---*---		
-44	34144	. GEAR, Spur	1	
-45	33083	. WASHER, Formed	1	
-46	41306-0000	. GEARING UNIT ASSEMBLY	1	E, F
-46	41306-0001	. GEARING UNIT ASSEMBLY	1	G, H
-47	33084-0002	. . PLATE ASSEMBLY	1	
		ATTACHING PARTS		
-48	104-0020	. . SCREW, Machine, bind hd, brs, ni pl, No. 4-40 thd by 5/16 in. lg	3	
-49	104-0024	. . SCREW, Machine, bind hd, brs, ni pl, No. 4-40 thd by 3/8 in. lg	3	
		---*---		
-50	34155	. . FLANGE	1	
-51	33089	. . GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-52	28665-0012	. . RING, Retaining (79136 part no. 5100-12-C)	1	
-53	17758-0000	. . SHIM, sst, 0.128 ID by 0.187 OD by 0.003 in. thk	AR	
		---*---		
-54	41302	. . CONTACT ASSEMBLY, Molded	1	
		ATTACHING PARTS		
-55	102-0032	. . SCREW, Machine, bind hd, brs, ni pl, No. 2-56 thd by 1/2 in. lg	2	
-56	4386	. . WASHER, Lock, split, brs, ni pl, No. 2	2	
		---*---		
-57	39091	. . PRINTED CIRCUIT ASSEMBLY	1	
		ATTACHING PARTS		
-58	502-0012	. . SCREW, Assembled washer, bind hd, ni pl, brs screw, sst lockwasher No. 2-56 thd by 3/16 in. lg	3	
-59	3873	. . TERMINAL	1	
		---*---		
-60	39013-2182	. . LAMP, Incandescent, 14 V (08806 part no. 2182D-FROSTED)	4	
-61	39090	. . . PRINTED CIRCUIT SUBASSEMBLY	1	
-62	7117-0000	. . WASHER, Flat	AR	
-63	28665-0018	. . RING, Retaining (79136 part no. 5100-18-C)	1	

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-3A -64	33270	. . GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-65	302-0006	. . SETSCREW, Spline soc dr, cup pt, stl, cad pl, No. 2-56 thd by 3/32 in. lg	2	
		---*---		
-66	41303	. . CONTACT PLATE ASSEMBLY	1	
		ATTACHING PARTS		
-67	304-0006	. . SETSCREW, Spline soc dr, cup pt, stl, cad pl, No. 4-40 thd by 3/32 in. lg	2	
-68	33093	. . POST	3	
-69	33148	. . GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-70	302-0006	. . SETSCREW, Spline soc dr, cup pt, stl, cad pl, No. 2-56 thd by 3/32 in. lg	2	
		---*---		
-71	33129	. . GEAR ASSEMBLY	1	
-72	33127	. . GEAR ASSEMBLY	1	
-73	33694	. . GEAR ASSEMBLY	1	
-74	30087	. . GEAR ASSEMBLY	1	G, H
		ATTACHING PARTS		
-75	304-0006	. . SETSCREW, Spline soc dr, cup pt, stl, cad pl, No. 4-40 thd by 3/32 in. lg	2	G, H
		---*---		
-76	14591	. . WASHER, Flat.	AR	
-77	40963	. . MOTOR, Control	1	
		ATTACHING PARTS		
-78	163-0020	. . SCREW, Machine, fil hd, brs, ni pl, No. 3-48 thd by 5/16 in. lg	2	
-79	4559	. . WASHER, Lock, split, brz, ni pl, No. 3	2	
-80	38409-0002	. . CLAMP, Rim clenching	2	
-81	4644	. . WASHER	2	
		---*---		
-82	37483-0000	. . GONIOMETER, Electrical (28308 part no. 10Hew0101/B05/0216)	1	
		ATTACHING PARTS		
-83	163-0024	. . SCREW, Machine, fil hd, brs, ni pl, No. 3-48 thd by 3/8 in. lg	3	
-84	4559	. . WASHER, Lock, split, brz, ni pl, No. 3	3	
-85	26804-0000	. . CLAMP, Rim clenching	3	
-86	26805-0004	. . SPACER, Sleeve	3	
		---*---		
-87	18008	. . SYNCHRO, Transmitter, 26 V, 400 Hz, 13 V, 100 Hz (88818 part no. RS911-4A)	1	G, H
		ATTACHING PARTS		
-88	163-0020	. . SCREW, Machine, fl hd, brs, ni pl, No. 3-48 thd by 5/16 in. lg	2	G, H
-89	4559	. . WASHER, Lock, split brz, ni pl, No. 3	2	G, H
-90	4664	. . WASHER	2	
-91	26804-0000	. . CLAMP, Rim clinching	2	G, H
-92	26805-0002	. . SPACER, Sleeve	2	G, H
		---*---		
-93	33489-0002	. . PLATE ASSEMBLY, Front	1	
-94	33227	. . GEAR, Spur	1	
		ATTACHING PARTS		
-95	302-0006	. . SETSCREW, Spline soc dr, cup pt, stl, cad pl. No. 2-56 thd by 3/32 in. lg	2	
		---*---		
-96	33152	. . GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-97	302-0006	. . SETSCREW, Spline soc dr, cup pt, stl, cad pl. No. 2-56 thd by 3/32 in. lg	2	
		---*---		
-98	33094	. . POST	3	
-99	33243	. . POST	4	
-100	33205	. . GEARING ASSEMBLY	1	
		ATTACHING PARTS		
-101	28665-0025	. . RING, Retaining (79136 part no. 5100-25-MD)	1	
-102	21623	. . WASHER, Flat	1	
		---*---		

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-3A -103	29857	. . . ARM ASSEMBLY	1	
		ATTACHING PARTS		
-104	102-0012	. . . SCREW, Machine, bind hd, brs, ni pl, No. 2-56 thd by 3/16 in. lg	1	
		---*---		
-105	29848	. . . PIN, Grooved	1	
		ATTACHING PARTS		
-106	28665-0012	. . . RING, Retaining (79136 part no. 5100-12-C)	1	
-107	17768-0000	. . . SHIM, sst, 0.128 ID by 0.187 OD by 0.003 in. thk	1	
		---*---		
-108	29849	. . . SPRING, Helical, torsion	1	
-109	33248	. . . DIAL, Printed	1	
		ATTACHING PARTS		
-110	502-0008	. . . SCREW, Assembled washer, bind hd, ni pl, brs screw, sst lockwasher No. 2-56 thd by 1/8 in. lg (78189 type SEMS)	2	
		---*---		
-111	33207	. . . PIN - Shoulder	1	
-112	30995	. . . WASHER, Flat	1	
-113	17831	. . . SPRING, Helical, extension	1	
-114	29852	. . . GEAR, Spur	1	
-115	30314	. . . GEAR, Spur	1	
-116	30996	. . . WASHER, Flat	1	
-117	8775-0442	. . . PIN, Spring	1	
-118	32208	. . . PLATE ASSEMBLY	1	
-119	33224	. . GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-120	28665-0018	. . RING, Retaining (79136 part no. 5100-18-C)	1	
-121	7117-0000	. . WASHER, Flat	AR	
		---*---		
-122	33533-0001	. . PLATE ASSEMBLY, Rear	1	



TP5313

I-346D Goniometer Indicators, Exploded View

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-3A -103	29857	. . . ARM ASSEMBLY	1	
		ATTACHING PARTS		
-104	102-0012	. . . SCREW, Machine, bind hd, brs, ni pl, No. 2-56 thd by 3/16 in. lg	1	
		---*---		
-105	29848	. . . PIN, Grooved	1	
		ATTACHING PARTS		
-106	28665-0012	. . . RING, Retaining (79136 part no. 5100-12-C)	1	
-107	17768-0000	. . . SHIM, sst, 0.128 ID by 0.187 OD by 0.003 in. thk	1	
		---*---		
-108	29849	. . . SPRING, Helical, torsion	1	
-109	33248	. . . DIAL, Printed	1	
		ATTACHING PARTS		
-110	502-0008	. . . SCREW, Assembled washer, bind hd, ni pl, brs screw, sst lockwasher No. 2-56 thd by 1/8 in. lg (78189 type SEMS)	2	
		---*---		
-111	33207	. . . PIN - Shoulder	1	
-112	30995	. . . WASHER, Flat	1	
-113	17831	. . . SPRING, Helical, extension	1	
-114	29852	. . . GEAR, Spur	1	
-115	30314	. . . GEAR, Spur	1	
-116	30996	. . . WASHER, Flat	1	
-117	8775-0442	. . . PIN, Spring	1	
-118	32208	. . . PLATE ASSEMBLY	1	
-119	33224	. . GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-120	28665-0018	. . RING, Retaining (79136 part no. 5100-18-C)	1	
-121	7117-0000	. . WASHER, Flat	AR	
		---*---		
-122	33533-0001	. . PLATE ASSEMBLY, Rear	1	

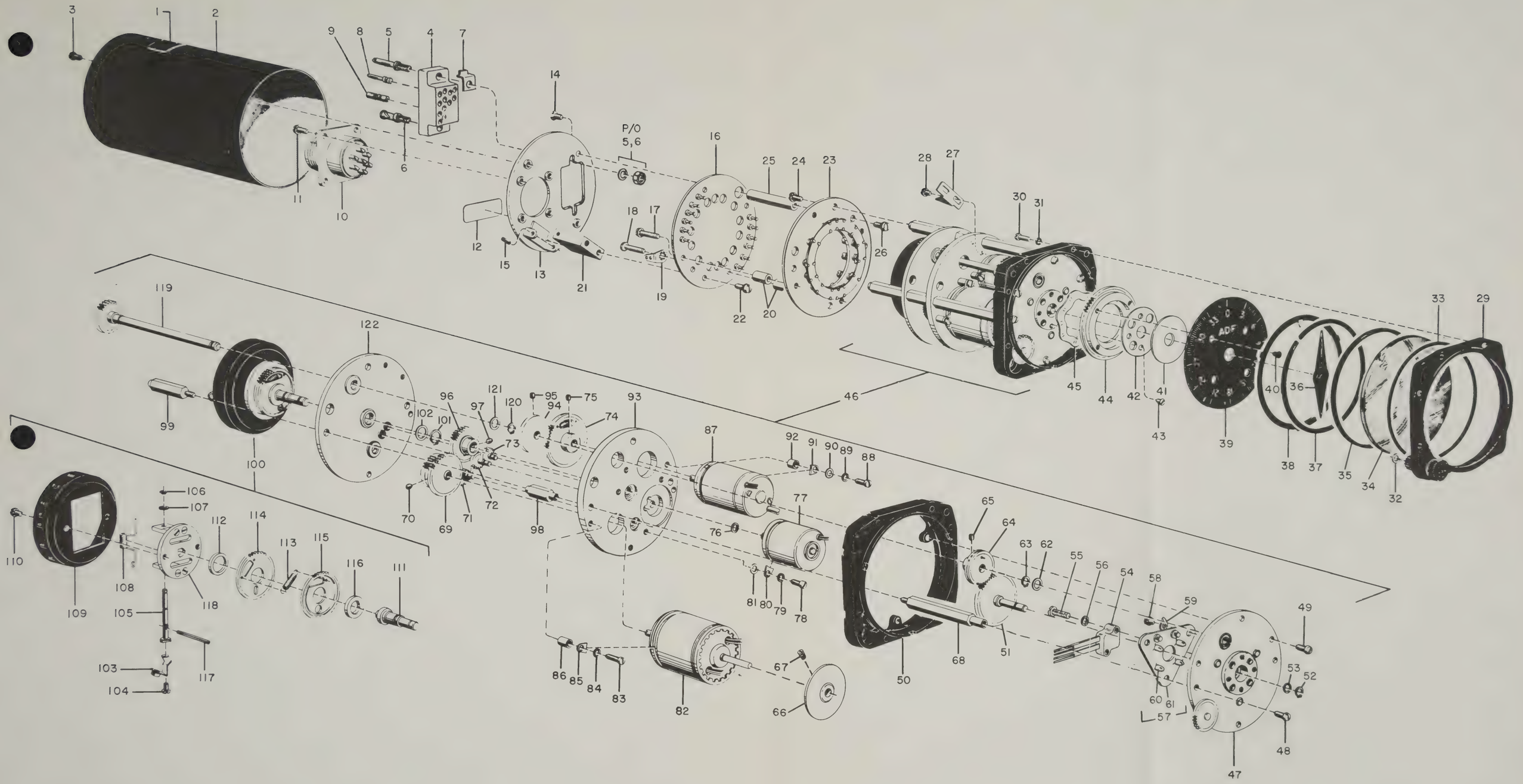


Figure 6-3A. IN-346C and IN-346D Goniometer Indicators, Exploded View

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-4 -	41340-0001	RECEIVER ACCESSORY, RA-346A	1	
	41340-0002	RECEIVER ACCESSORY, RA-346B	1	
-1	35876-0001	. COVER ASSEMBLY	1	
-2	41302	. CONTACT ASSEMBLY, Molded (Used on RA-346B)	1	
		ATTACHING PARTS		
-3	102-0028	. SCREW, Machine, bind. hd, brs, ni pl, No. 2-56 . . . . . thd by 7/16 in. lg (Used on RA-346B)	2	
-4	4386	. WASHER, Lock, split, sst, No. 4 (Used on RA-346B)	2	
		---*---		
-5	41302	. CONTACT ASSEMBLY, Molded	1	
		ATTACHING PARTS		
-6	102-0028	. SCREW, Machine, bind. hd, brs, ni pl, ... No. 2-56 by 7/16 in. lg	2	
-7	4386	. WASHER, Lock, split, sst, No. 4	2	
		---*---		
-8	41353	. BRACKET (Used on RA-346B).	1	
		ATTACHING PARTS		
-9	142-0012	. SCREW, Machine, fh, brs, ni pl, No. 2-56 thd . . . . . by 3/8 in. lg (Used on RA-346B)	2	
		---*---		
-10	41353	. BRACKET.	1	
		ATTACHING PARTS		
-11	142-0012	. SCREW, Machine, fh, brs, ni pl No. 2-56 thd by . . . . . 3/8 in. lg	2	
		---*---		
-12	41354	. PLATE ASSEMBLY, Contacting (Used on RA-346B)	1	
		ATTACHING PARTS		
-13	304-0006	. SETSCREW, Fluted soc dr, cup pt, stl, cad. pl, No. 4-40NC- . . . . 3A thd by 3/32 in. lg (Used on RA-346B)	2	
		---*---		
-14	41354	. PLATE ASSEMBLY, Contacting	1	
		ATTACHING PARTS		
-15	304-0006	. SETSCREW, Fluted soc dr, cup pt, stl, cad. pl, ... No. 4-40NC-3A thd by 3/32 in. lg	2	
		---*---		
-16	36012-0002	. GEARING UNIT ASSEMBLY (Used on RA-346B) . . . . . (See Figure 6-5)	1	
		ATTACHING PARTS		
-17	29895-4016	. SCREW, Machine, rh, Phillips dr, brs, cad. pl, ... No. 4-40NC-2A thd by 1/4 in. lg (AN505PB4R4) (Used on RA-346B)	4	
		---*---		
-18	29877-0003	. GEARING UNIT ASSEMBLY (See Figure 6-5)	1	
		ATTACHING PARTS		
-19	29895-4016	. SCREW, Machine, rh, Phillips dr, brs, cad. pl, ... No. 4-40NC-2A thd by 1/4 in. lg (AN505PB4R4)	4	
		---*---		
-20	36011	. DIAL ASSEMBLY, Control (Used on RA-346B)	1	
		ATTACHING PARTS		
-21	322-0008	. SETSCREW, Hexagon soc dr, cup pt, stl, cad. pl, ... No. 2-56 thd by 1/8 in. lg (AN565DC2H2) (Used on RA-346B)	2	
		---*---		
-22	29861	. DIAL ASSEMBLY, Control	1	
		ATTACHING PARTS		
-23	322-0008	. SETSCREW, Hexagon soc dr, cup pt, stl, cad. pl, ... No. 2-56 thd by 1/8 in. lg	2	
		---*---		
-24	30718-0005	. CONNECTOR, Electrical (02660 part no. 94-65940)	1	
		ATTACHING PARTS		
-25	29896-4012	. SCREW, Machine, rh, Phillips dr, brs, cad. pl, ... No. 4-40 thd by 3/16 in. lg (AN515PB4R3)	6	
-26	29898-3004	. WASHER, Lock, split, brz, cad. pl, No. 4 . . . . . (AN935B4L)	6	
		---*---		

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-4 -27	32481	. WINDOW (Used on RA-346B)	1	
		ATTACHING PARTS		
-28	142-0008	. SCREW, Machine, fh, brs, ni pl, No. 2-56 . . . . . thd by 1/8 in. lg (Used on RA-346B)	4	
		---*---		
-29	32481	. WINDOW	1	
		ATTACHING PARTS		
-30	142-0008	. SCREW, Machine, fh, brs, ni pl, No. 2-56 . . . . . thd by 1/8 in. lg	4	
		---*---		
-31	30455-0831	. PLUG, Button	1	
-32	31059-0001	. COVER ASSEMBLY	1	
-33	22237-0000	. STUD, Snapslide fastener	2	
-34	4647-0001	. WASHER, Flat, phosphor brz, cad. pl, ... 0.140 ID by 0.187 OD, by 0.010 in. thk	AR	
-35	24175-9148	. HANDLE, Bow	1	
-36	22138-0000	. COLLAR, Shaft	2	
		ATTACHING PARTS		
-37	29896-6020	. SCREW, Machine, rh, Phillips dr, brs, cad. pl, ... No. 6-32 thd by 5/16 in. lg (AN515PB6R5)	2	
-38	29898-3006	. WASHER, Lock, split, brz, cad. pl, ... No. 6 (AN935B6L)	2	
		---*---		
-39	41342-0001	. PLATE, Identification (Used on RA-346A)	1	
	41342-0002	. PLATE, Identification (Used on RA-346B)	1	
		ATTACHING PARTS		
-40	30145-2012	. SCREW, Tapping, thd forming, pan hd, Phillips dr, ... CRES, No. 2 by 3/16 in. lg	2	
		---*---		
-41	22394-0000	. BRACKET, Angle	1	
		ATTACHING PARTS		
-42	30454-6020	. SCREW, Machine, rh, Phillips dr, CRES, ... No. 3-48 thd by 5/16 in. lg	2	
-43	29898-3006	. WASHER, Lock, split, brz, cad. pl, ... No. 6 (AN935B6L)	2	
		---*---		
-44	31040-0002	. COVER, Front	1	
		ATTACHING PARTS		
-45	30454-3016	. SCREW, Machine, rh, Phillips dr, CRES, ... No. 3-48 thd by 1/4 in. lg	2	
-46	29898-3003	. WASHER, Lock, split, brz, cad. pl, ... No. 3 (AN935B3L)	2	
		---*---		
-47	35874-0001	. CHASSIS ASSEMBLY	1	

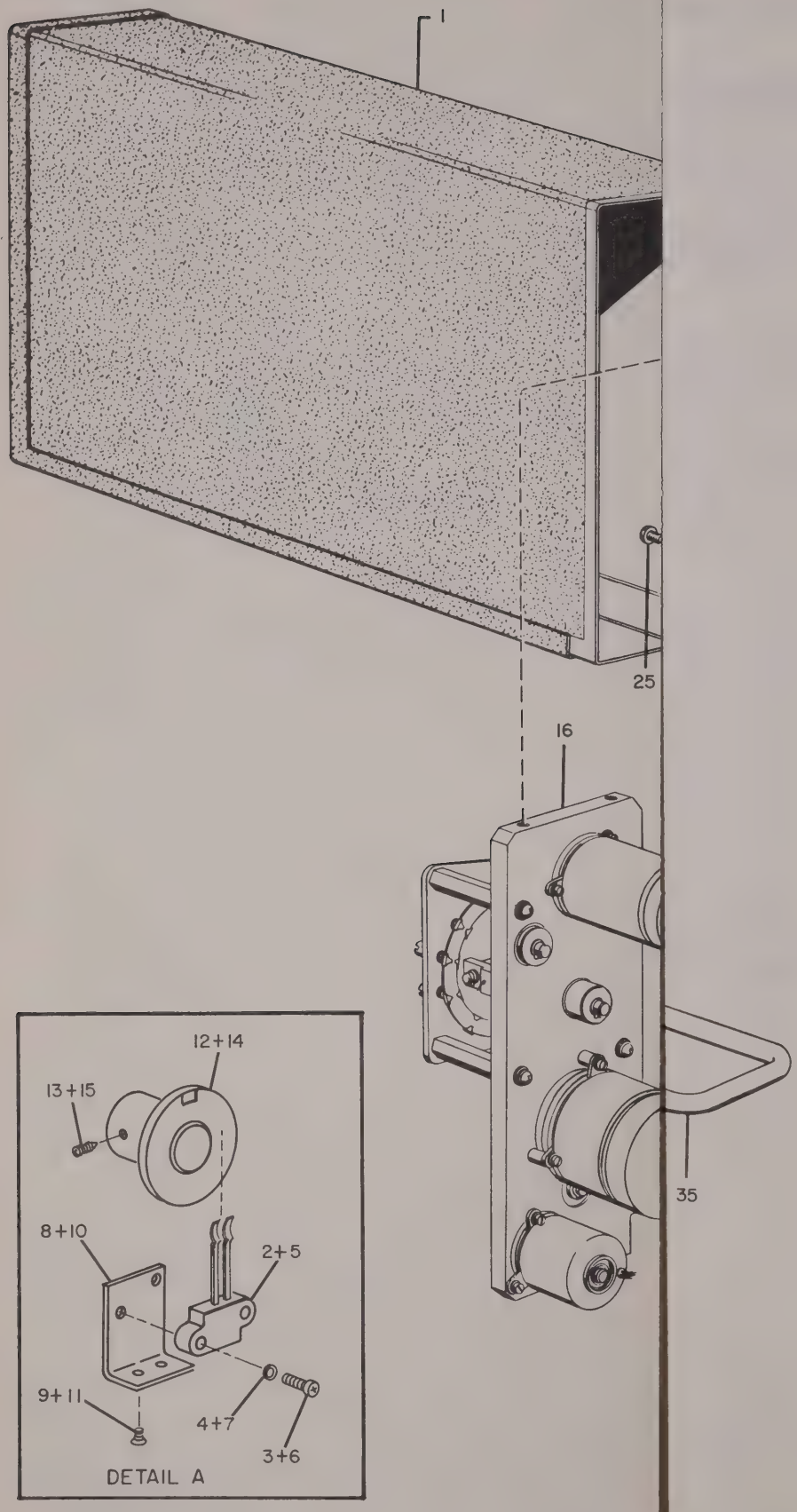


Figure 6-4. RA-346A or RA-346E

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-5 -	36012-0002	GEARING UNIT ASSEMBLY (Used on RA-346B) . . . . . (See 16, Figure 6-4)	Ref	
	29877-0003	GEARING UNIT ASSEMBLY (See 18, Figure 6-4)	Ref	
-1	36052	. PLATE ASSEMBLY (Used on Part No. . . . . 36012-0002)	1	
	30079	. PLATE ASSEMBLY (Used on Part No. . . . . 29877-0003)	1	
		ATTACHING PARTS		
-2	30454-4020	. SCREW, Machine, rh, Phillips dr, CRES, ... No. 4-40 thd by 3/8 in. lg (AN515C4R5)	4	
-3	29898-3004	. WASHER, Lock, split, brz, cad. pl, ... No. 4 (AN935B4L)	4	
-4	28558-1004	. WASHER, Flat, CRES, No. 4 (AN960C4)	4	
		---*---		
-5	30086	. POST	4	
		ATTACHING PARTS		
-6	30454-4024	. SCREW, Machine, rh, Phillips dr, CRES, ... No. 4-40 thd by 3/8 in. lg (AN515C4R6)	4	
-7	29898-3004	. WASHER, Lock, split, brz, cad. pl, ... No. 4 (AN935B4L)	4	
-8	28558-1004	. WASHER, Flat, CRES, No. 4 (AN960C4)	4	
		---*---		
-9	30087	. GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-10	322-4008	. SETSCREW, Hexagon soc dr, cup pt, stl, cad. pl, ... No. 4-40 thd by 1/8 in. lg (AN565DC4H2)	2	
		---*---		
-11	29844	. GEARING ASSEMBLY	1	
		ATTACHING PARTS		
-12	28665-0018	. RING, Retaining (79136 Part No. 5100-18-C) . . . . . (MS16624-18)	1	
-13	17765-0001	. SHIM, CRES, 0.190 ID by 0.234 OD by 0.003 in. thk	AR	
		---*---		
-14	30996	. . WASHER, Flat, stl, passivate fin., 0.2812 ID by . . . . . 0.500 OD by 0.062 in. thk	1	
-15	30314	. . GEAR, Spur	1	
-16	17831	. . SPRING, Helical, extension	1	
-17	29852	. . GEAR, Spur	1	
-18	30995	. . WASHER, Flat, stl, passivate fin., 0.380 ID by . . . . . 0.500 OD by 0.040 in. thk	1	
-19	29845	. . PIN, Shoulder, headless	1	
-20	8775-0442	. . PIN, Spring	1	
-21	29857	. . ARM ASSEMBLY	1	
		ATTACHING PARTS		
-22	29896-2012	. . SCREW, Machine, rh, brs, cad. pl, No. 2-56 thd . . . . . by 3/16 in. lg (AN515PB2R3)	1	
		---*---		
-23	29848	. . PIN, Grooved, headed	1	
		ATTACHING PARTS		
-24	28665-0012	. . RING, Retaining (79136 Part No. 5100-12-C)	2	
-25	17768-0000	. . SHIM, Sst, 0.128 ID by 0.187 OD by 0.003 in. thk	1	
		---*---		
-26	29849	. . SPRING, Helical, torsion	1	
-27	30088	. . GEAR SUBASSEMBLY	1	
-28	18008	. SYNCHRO, Transmitter, 26 V, 400 Hz, 13 V, 100 Hz . . . . . (88818 Part No. RS911-4A)	1	
		ATTACHING PARTS		
-29	29897-3016	. SCREW, Machine, fil h, stl, passivate fin., No. 3-48 . . . . . thd by 1/4 in. lg (AN500D3-4)	3	
-30	29898-3003	. WASHER, Lock, split, brz, cad. pl, No. 3 (AN935B3L)	3	
-31	26804-0001	. CLAMP, Rim clenching	3	
		---*---		
-32	29854	. GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-33	28665-0018	. RING, Retaining (79136 Part No. 5100-18-C) . . . . . (MS16624-18)	1	

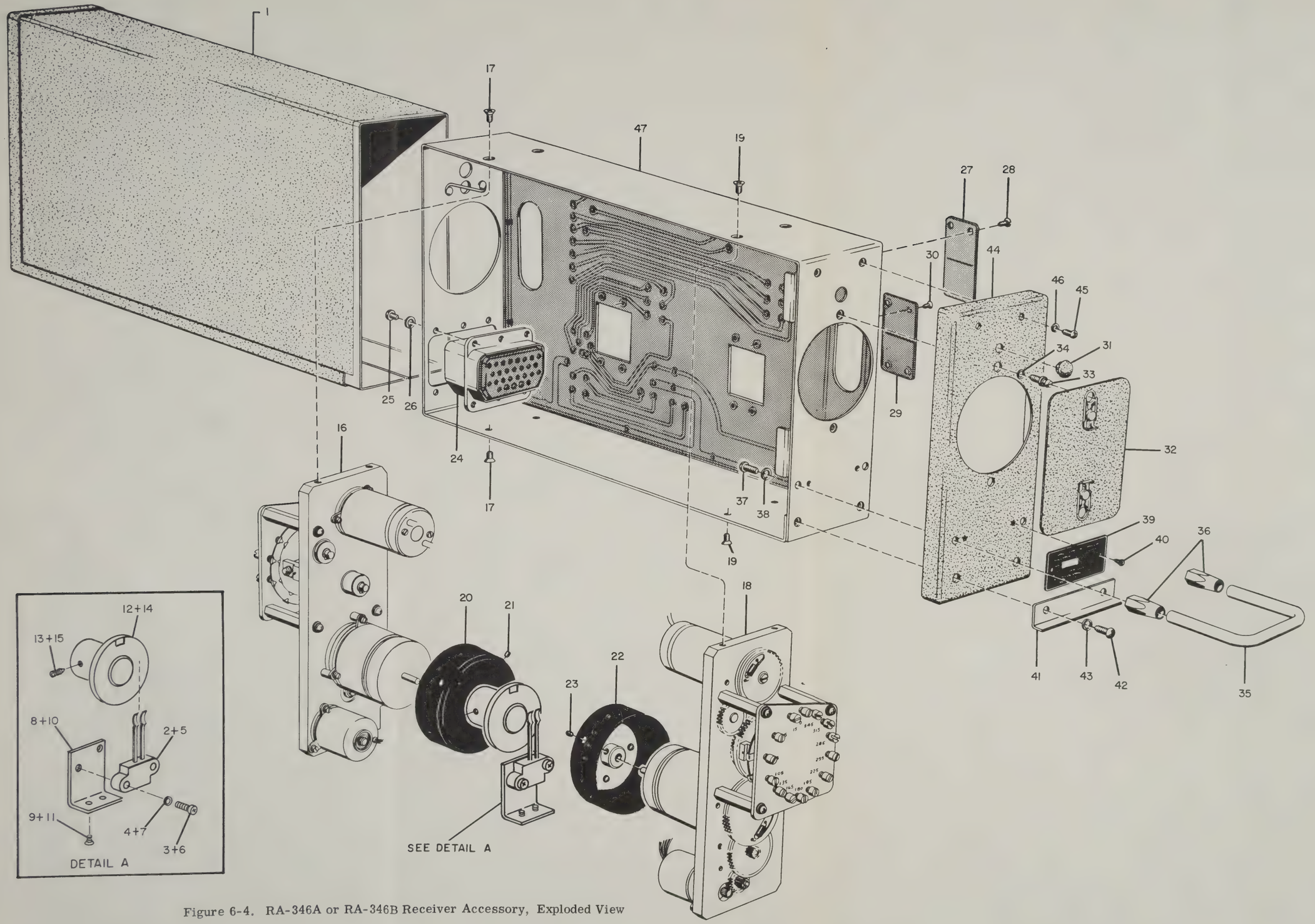


Figure 6-4. RA-346A or RA-346B Receiver Accessory, Exploded View

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-5 -	36012-0002	GEARING UNIT ASSEMBLY (Used on RA-346B) . . . . . (See 16, Figure 6-4)	Ref	
	29877-0003	GEARING UNIT ASSEMBLY (See 18, Figure 6-4)	Ref	
-1	36052	. PLATE ASSEMBLY (Used on Part No. . . . . 36012-0002)	1	
	30079	. PLATE ASSEMBLY (Used on Part No. . . . . 29877-0003)	1	
		ATTACHING PARTS		
-2	30454-4020	. SCREW, Machine, rh, Phillips dr, CRES, ... No. 4-40 thd by 3/8 in. lg (AN515C4R5)	4	
-3	29898-3004	. WASHER, Lock, split, brz, cad. pl, ... No. 4 (AN935B4L)	4	
-4	28558-1004	. WASHER, Flat, CRES, No. 4 (AN960C4)	4	
		---*---		
-5	30086	. POST	4	
		ATTACHING PARTS		
-6	30454-4024	. SCREW, Machine, rh, Phillips dr, CRES, ... No. 4-40 thd by 3/8 in. lg (AN515C4R6)	4	
-7	29898-3004	. WASHER, Lock, split, brz, cad. pl, ... No. 4 (AN935B4L)	4	
-8	28558-1004	. WASHER, Flat, CRES, No. 4 (AN960C4)	4	
		---*---		
-9	30087	. GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-10	322-4008	. SETSCREW, Hexagon soc dr, cup pt, stl, cad. pl, ... No. 4-40 thd by 1/8 in. lg (AN565DC4H2)	2	
		---*---		
-11	29844	. GEARING ASSEMBLY	1	
		ATTACHING PARTS		
-12	28665-0018	. RING, Retaining (79136 Part No. 5100-18-C) . . . . . (MS16624-18)	1	
-13	17765-0001	. SHIM, CRES, 0.190 ID by 0.234 OD by 0.003 in. thk	AR	
		---*---		
-14	30996	. . WASHER, Flat, stl, passivate fin., 0.2812 ID by . . . . . 0.500 OD by 0.062 in. thk	1	
-15	30314	. . GEAR, Spur	1	
-16	17831	. . SPRING, Helical, extension	1	
-17	29852	. . GEAR, Spur	1	
-18	30995	. . WASHER, Flat, stl, passivate fin., 0.380 ID by . . . . . 0.500 OD by 0.040 in. thk	1	
-19	29845	. . PIN, Shoulder, headless	1	
-20	8775-0442	. . PIN, Spring	1	
-21	29857	. . ARM ASSEMBLY	1	
		ATTACHING PARTS		
-22	29896-2012	. . SCREW, Machine, rh, brs, cad. pl, No. 2-56 thd . . . . . by 3/16 in. lg (AN515PB2R3)	1	
		---*---		
-23	29848	. . PIN, Grooved, headed	1	
		ATTACHING PARTS		
-24	28665-0012	. . RING, Retaining (79136 Part No. 5100-12-C)	2	
-25	17768-0000	. . SHIM, Sst, 0.128 ID by 0.187 OD by 0.003 in. thk	1	
		---*---		
-26	29849	. . SPRING, Helical, torsion	1	
-27	30088	. . GEAR SUBASSEMBLY	1	
-28	18008	. SYNCHRO, Transmitter, 26 V, 400 Hz, 13 V, 100 Hz . . . . . (88818 Part No. RS911-4A)	1	
		ATTACHING PARTS		
-29	29897-3016	. SCREW, Machine, fil h, stl, passivate fin., No. 3-48 . . . . . thd by 1/4 in. lg (AN500D3-4)	3	
-30	29898-3003	. WASHER, Lock, split, brz, cad. pl, No. 3 (AN935B3L)	3	
-31	26804-0001	. CLAMP, Rim clenching	3	
		---*---		
-32	29854	. GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-33	28665-0018	. RING, Retaining (79136 Part No. 5100-18-C) . . . . . (MS16624-18)	1	

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-5 -34	17765-0001	. SHIM, CRES, 0.190 ID by 0.234 OD by 0.003 in. thk ---*---	AR	
-35	31058	. GEAR ASSEMBLY ATTACHING PARTS	1	
-36	322-2008	. SETSCREW, Hexagon, soc dr, cup pt, stl, cad. pl, No. 2-56 thd by 1/8 in. lg (AN565DC2H2) ---*---	2	
-37	39371	. GONIOMETER KIT, Bendix (Consists of Goniometer, Part No. 32043, and 3 each Spacers, Part No. 26805-1003) (alternate for Part No. 39372)	1	
	39372	. GONIOMETER KIT, Scot (Consists of Goniometer Part No. 37483-0001, and 3 each Spacers, Part No. 26805-1004) (alternate for Part No. 39371) ATTACHING PARTS	1	
-38	29897-3028	. SCREW, Machine, fil h, stl, passivate fin., No. 3-48 thd by 7/16 in. lg (AN500D3-7)	3	
-39	29898-3003	. WASHER, Lock, split, brz, cad. pl, No. 3 (AN935B3L)	3	
-40	26804-0001	. CLAMP, Rim clenching. ---*---	3	
-41	31055	. GEAR SUBASSEMBLY ATTACHING PARTS	1	
-42	28665-0012	. RING, Retaining (79136 Part No. 5100-12-C) (MS16624-12)	1	
-43	17768-0001	. SHIM, CRES, 0.128 ID by 0.187 OD by 0.0003 in. thk ---*---	AR	
-44	32706	. GEAR SUBASSEMBLY ATTACHING PARTS	1	
-45	30323-0009	. RING, Retaining (79136 Part No. 5133-9-MD) (MS16633-1009) ---*---	1	
-46	40963	. MOTOR, Control ATTACHING PARTS	1	
-47	29897-3020	. SCREW, Machine, fil h, stl, passivate fin., No. 3-48 thd by 5/16 in. lg (AN500D3-6)	3	
-48	29898-3003	. WASHER, Lock, split, brz, cad. pl, No. 3 (AN935B3L)	3	
-49	38409-0002	. CLAMP, Rim clenching	3	
-50	7475	. TERMINAL ---*---	1	
-51	29017	. WASHER, Flat, sst, passivated, 0.516 ID by 0.687 OD by 0.005 in. thk	2	
-52	36010	. PLATE ASSEMBLY (Used on part no. 36012-0002)	1	
	31052-0001	. PLATE ASSEMBLY (Used on part no. 29877-0003)	1	

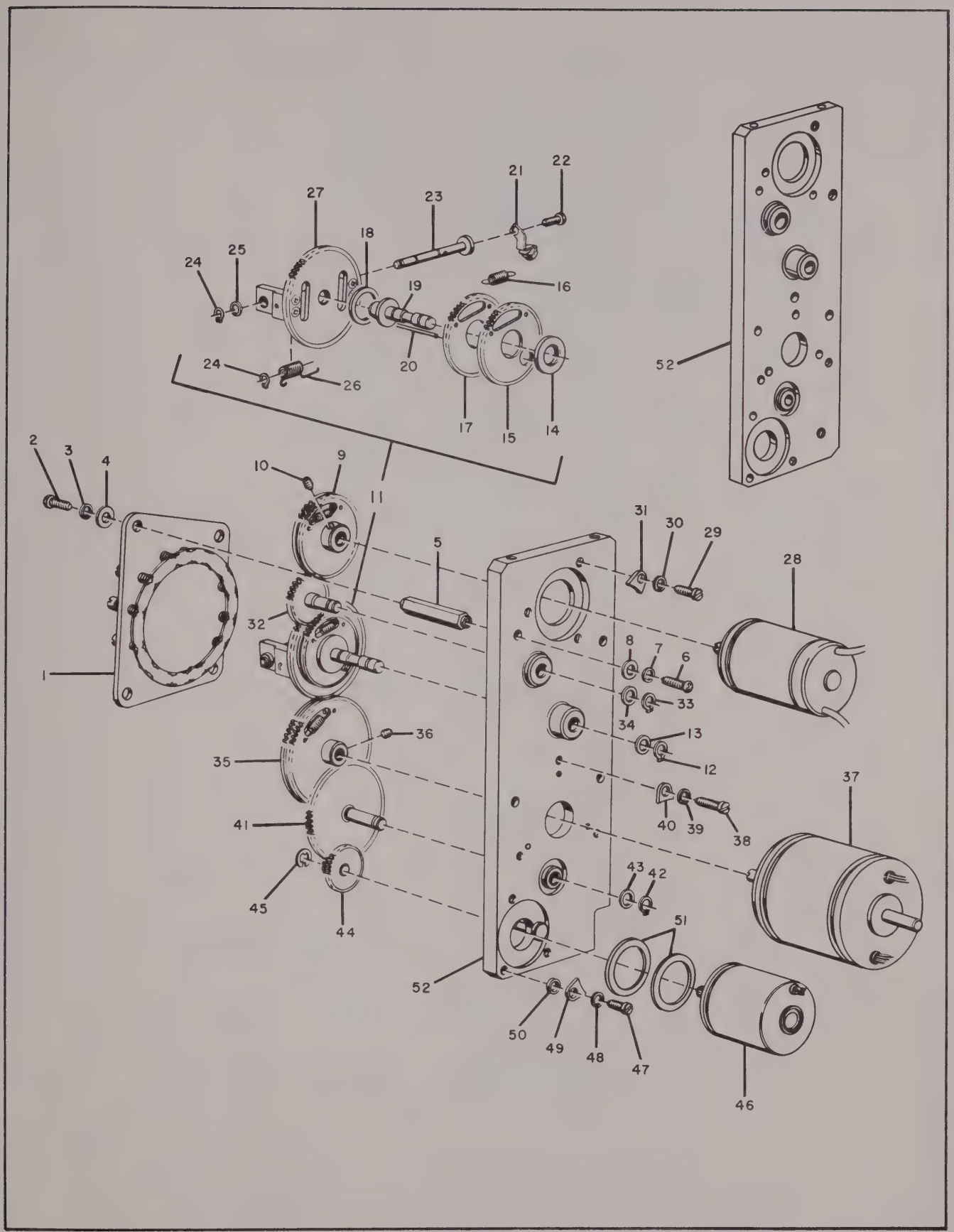


Figure 6-5. RA-346A or RA-346B Receiver Accessory, Gearing Unit Assembly, Exploded View

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-6 -	41950	RECEIVER ACCESSORY, RA-446A	1	
- 1	42093	. PLATE, Information	1	
- 2	32775-0001	. COVER	1	
		ATTACHING PARTS		
- 3	514-0016	. SCREW, Assembled washer, bind hd, brs screw, sst lockwasher, blk oxidized No. 4-40 thd by 1/4 in. lg (78189 type SEMS)	2	
		---*---		
- 4	42056/16453	. PLATE W/INSERTS	1	
		ATTACHING PARTS		
- 5	104-0016	. SCREW, Machine, bind, he, brs, ni pl, No. 2-56 thd by 1/4 in. lg	4	
- 6	22341	. WASHER	4	
		---*---		
- 7	41302	. CONTACT ASSEMBLY, Molded	1	
		ATTACHING PARTS		
- 8	102-0032	. SCREW, Machine, fh, brs, ni pl, No. 2-56 thd by 1/2 in. lg	2	
- 9	29898-3002	. WASHER, Lock, brz cad pl, No. 2 (AN935B2L)	2	
		---*---		
-10	41524	. BRACKET ASSEMBLY	1	
		ATTACHING PARTS		
-11	504-0024	. SCREW, Assembled washer, bind ni pl, brs screw, sst lockwasher No. 4-40 thd by 3/8 in. lg (78189 type SEMS)	3	
		---*---		
-12	41509	. SPACER	1	
		ATTACHING PARTS		
-13	144-0016	. SCREW, Machine, fh, brs, ni pl, No. 4-40 thd by 1/4 in. lg	1	
		---*---		
-14	31169-0000	. CONNECTOR, Receptacle, electrical (J1) (MS3102R16S-1P)	1	
		ATTACHING PARTS		
-15	339-4020	. SCREW, Tapping, thd forming, phillips dr, pan hd, stl, cad pl, No. 4 by 5/16 in. lg	4	
		---*---		
-16	30455-0031	. PLUG, Button	1	
-17	35860-0118	. CONNECTOR, Receptacle, electrical (J2)	1	
		ATTACHING PARTS		
-18	—	. NUT, Hexagon (supplied with 35862-0001 and -0002)	2	
-19	—	. WASHER, Lock (supplied with 35862-0001 and -0002)	2	
-20	35862-0001	. GUIDE, Socket	1	
-21	35862-0002	. GUIDE, Pin	1	
-22	29916-0001	. TABS, Lock (1 set)	1	
		---*---		
-23	35861-0122	. CONTACT, Electrical	18	
-24	41952-0002	. PLATE, Identification	1	
-25	42044	. GEARING UNIT ASSEMBLY	1	
-26	41529	. . GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-27	30323-0009	. . RING, Retaining (79136 part no. 5133-9MD) (MS16633-1009)	1	
		---*---		
-28	41528	. . GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-29	30323-0009	. . RING, Retaining (79136 part no. 5133-9MD) (MS16633-1009)	1	
		---*---		
-30	41527	. . GEAR ASSEMBLY	1	
		ATTACHING PARTS		
-31	30323-0009	. . RING, Retaining (79136 part no. 5133-9-MD) (MS16633-1009)	1	
		---*---		
-32	41526	. . GEAR ASSEMBLY	2	
		ATTACHING PARTS		
-33	304-0006	. . SETSCREW, Spline soc dr, cup pt, stl, cad pl, No. 4-40 thd by 3/32 in. lg	2	
		---*---		

FIGURE AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6-6 -34	41532	. . GEAR ASSEMBLY	1	C, D
		ATTACHING PARTS		
-35	304-0006	. . SETSCREW, Spline soc dr, cup pt, stl, cad pl, No. 4-40 thd by 3/32 in. lg	2	C, D
		---*---		
-36	40963	. . MOTOR, Control	1	
		ATTACHING PARTS		
-37	163-0020	. . SCREW, Machine, fil hd, brs, ni pl, No. 3-48 thd by 5/16 in. lg	2	
-38	4559	. . WASHER, Lock, split, brz, ni pl, No. 3	2	
-39	26804-0000	. . CLAMP, Rim clenching	2	
-40	26805-0001	. . SPACER, Sleeve	2	
		---*---		
-41	37483-0000	. . GONIOMETER, Electrical (28308 part no. 10Hew0101/B02/0216)	1	
		ATTACHING PARTS		
-42	163-0020	. . SCREW, Machine, fil hd, brs, ni pl, No. 3-48 thd by 5/16 in. lg	3	
-43	4559	. . WASHER, Lock, split, brz, ni pl, No. 3	3	
-44	3873	. . TERMINAL	1	
-45	26804-0000	. . CLAMP, Rim clenching	3	
-46	26805-0004	. . SPACER, Sleeve	3	
		---*---		
-47	18008	. . SYNCHRO, Transmitter, 26 V, 400 Hz, 13 V, 100 Hz (88818 part no. RS911-4A)	1	
		ATTACHING PARTS		
-48	163-0020	. . SCREW, Machine, fil hd, brs, ni pl, No. 3-48 thd by 5/16 in. lg	2	
-49	4559	. . WASHER, Lock, split, brz, ni pl, No. 3	2	
-50	26804-0000	. . CLAMP, Rim clenching	2	
-51	26805-0006	SPACER, Sleeve	2	
		---*---		
-52	42043	. . PLATE ASSEMBLY	1	

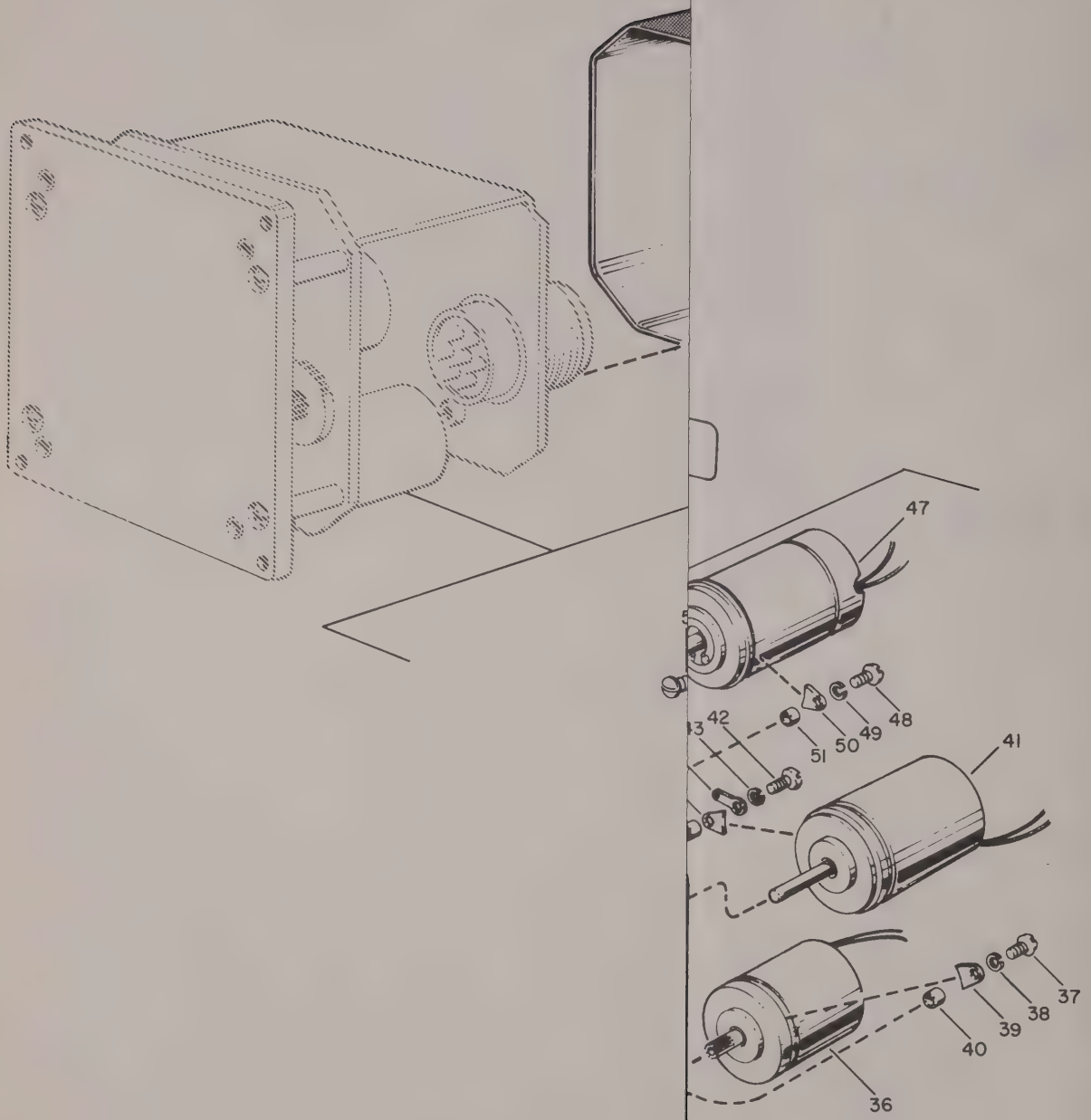


Figure 6-6. RA-446A Receiver Accesory,

Part No.	Figure and Index No.
NUT	6-2-11
	6-2-30
	6-2-40
	6-2A-38
	6-3A-4A
	6-6-18
WASHER	6-2A-39
	6-3-4B
	6-6A-19
102-0012	6-1-63
	6-2-74
	6-2A-10
	6-2A-20
	6-3-102
	6-3A-104
102-0016	6-1-17
	6-1-48
	6-2-5
	6-2-14
102-0028	6-4-3
	6-4-6
102-0032	6-2A-28
	6-3A-55
	6-6-8
104-0016	6-6-5
104-0020	6-3-46
	6-3A-48
104-0024	6-3-47
	6-3-49
104-0040	6-3-16
	6-3A-18
104-0056	6-1-29
	6-2A-6
11816	6-3-20
	6-3A-32
11884	6-1-58
13473	6-2-6
	6-2-15
13527	6-2A-60
142-0008	6-4-28
	6-4-30
142-0012	6-4-9
	6-4-11
142-0016	6-3-41
	6-3A-43
142-0032	6-3-63
144-0016	6-2A-33
	6-3-12
	6-3A-14
	6-6-13
144-0028	6-1-21
14591	6-3A-76
152-0012	6-3-38
	6-3A-40
163-0020	6-2A-63
	6-2A-68
	6-2A-74
	6-3-79
	6-3-82
	6-3A-78
	6-3A-88
	6-6-37
	6-6-42
	6-6-48
163-0024	6-3-87
	6-3A-83
168-0132	6-2-2
174-0028	6-3-28
	6-3A-30
17765-0001	6-5-13
	6-5-34
17768-0000	6-2-44
	6-2-55
	6-2-61
	6-2-66
	6-2A-61
	6-3-51
	6-3-77
	6-3-105
	6-3A-53
	6-3A-107
	6-5-25
17768-0001	6-5-43
17831	6-3-111
	6-3A-113
	6-5-16
18008	6-2A-73
	6-3A-87
	6-5-28
	6-6-47
194-0012	6-1-23
	6-1-25
	6-1-27
	6-1-39
	6-1-53
19454-0003	6-1-54
20097-0134	6-3-21
	6-3A-25
20249	6-3-31
	6-3A-33
20250	6-3-33
	6-3A-35
20261	6-3-35
	6-3A-37
21623	6-2-51
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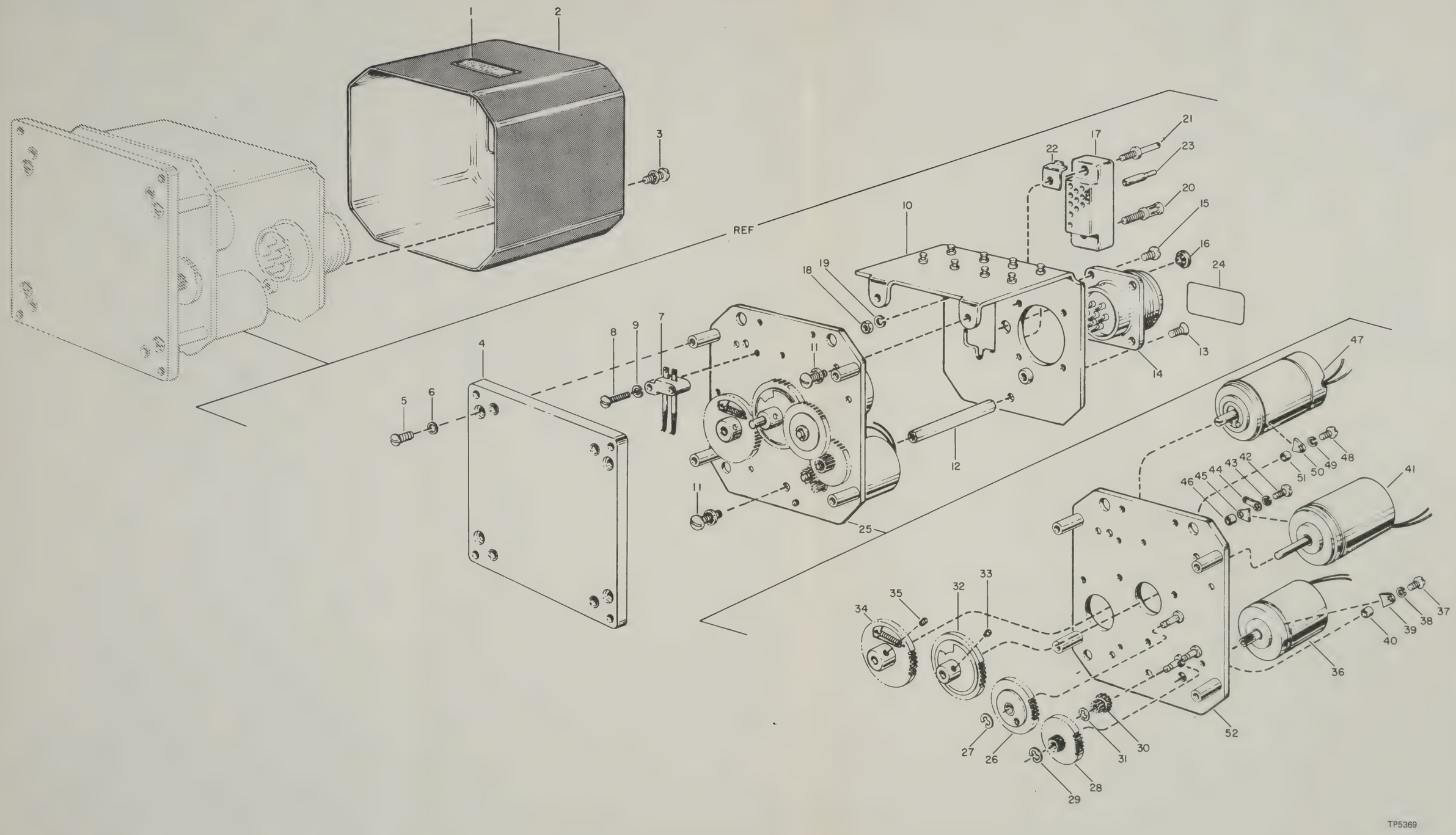

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